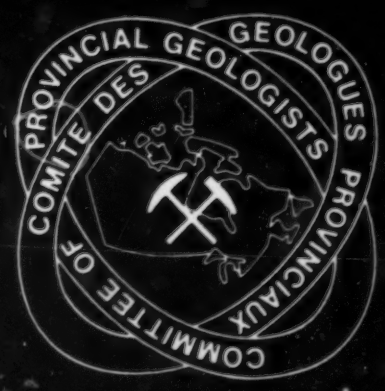

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1999 Committee of Provincial Geologists *inside back cover*

COMMITTEE OF PROVINCIAL GEOLOGISTS CHAIRPERSON'S REPORT 1999

The Committee of Provincial Geologists (CPG) met three times: in Vancouver in January 1999 (Cordilleran Roundup); in Toronto in March 1999 (PDAC); and in Charlottetown in September 1999 (Energy and Mines Ministers Conference). Each of these meetings involved, or immediately preceded, a meeting that included our colleagues from the Geological Survey of Canada (Natural Resources Canada) under the auspices of the National Geological Surveys Committee (NGSC).

CPG is involved in a number of activities, many in collaboration with the Geological Survey of Canada (GSC), including: a) Team Canada marketing displays at the Annual Meeting of the Prospectors and Developers Association, in Toronto; b) participation on an industry-lead task force, appointed by the Intergovernmental Working Group on the Mineral Industry, to address "Funding Government Geological Surveys: How Much Is Enough?"; c) an initiative to provide digital access to pan-Canadian geoscience information via the Internet, referred as the National Geoscience Knowledge Network; d) establishment of national geoscience priorities to guide national geoscience planning; and e) the establishment of a NGSC Liaison position, residing in the GSC.

At the September 1999 Energy and Mines Ministers Conference in Prince Edward Island, the inaugural Provincial Geologists Medal was presented to Bruce Ryan, a senior geoscientist with the Geological Survey of the Newfoundland Department of Mines and Energy. Bruce was recognized for his contributions to the understanding of the geological evolution of Labrador.

Jan Boon very ably Chaired the CPG for the past 1.5 years, until September 1999. Subsequently, Jan Boon accepted a secondment opportunity with the GSC, as the NGSC Liaison person and will be based in Ottawa. This position was previously very capably filled by Mike Cherry who made many significant contributions and helped build the trust and collaboration between the GSC and CPG organizations. The secondment opportunity became available when Mike Cherry moved to Nova Scotia (see below). The liaison position was established by NGSC within the GSC in recognition of the importance of the collaboration between the GSC and the provincial/territorial geological surveys. The position provides ongoing advice to the GSC Chief Geoscientist and Director Generals regarding the requirements of the Intergovernmental Geoscience Accord and subsidiary agreements vis-à-vis GSC policy development and decision making that affect Provincial/Territorial geological survey mandates and obligations. This function will help ensure communication and awareness between the managers and scientific staff of the GSC and provincial/territorial geological surveys.

CPG received three new faces this year: 1) Mike Cherry joined as Director of the Nova Scotia Mineral and Energy Resources Division; 2) Rick Richarson joined as senior Team Leader, Alberta Geological Survey, following the secondment of Jan Boon to the GSC; 3) Gordon MacKay joined as the Assistant Director, Minerals, Oil & Gas, Nunavut Resources, Wildlife & Economic Development.

During the past year, NGSC established a set of national geoscience needs, summarized below. These needs will help guide the GSC in setting its program priorities.

The report on "Funding Government Geological Surveys: How Much Is Enough?", prepared by an industry-lead task force, appointed by the Intergovernmental Working Group on the Mineral Industry, is included in the Appendix. A key challenge facing NGSC during the up-coming year is the development of a national geoscience mapping strategy.

Once again, British Columbia professionally produced the 1999 Provincial Geologists Journal.

Andy Fyon
CPG Chair, 1999

List of National Geoscience Needs, Set by the Committee of Provincial Geologists for input to Geological Survey of Canada planning:

Most Important

- Address declining metal reserves by undertaking thematic national and international studies of known mineral deposits.
- Expedite the production of bedrock map data at a national or broadly regional scale.
- Maintain or enhance collaborative programs (such as NATMAP and EXTECH) that contribute to Canada's geological framework.
- Continue the development and provision of speciality techniques and facilities (e.g., geochronology, paleontology, and isotope geochemistry) to support broader geoscience activities.

Very Important

- Expedite surficial geological mapping of Canada at a national or broadly regional scale.
- Expedite the production of aeromagnetic map data to current technological standard.
- Characterize geological hazards.
- Undertake geoscience studies to develop an understanding of how earth processes affect ecosystem stability and human activities.
- Expedite the digitising, linking and dissemination of all Canadian geoscience data and information, including the development of data standards (Map data have the highest priority).
- Expedite the production of geochemical map data to current technological standard at a national or broadly regional scale.

Important

- Increase marine and coastal geoscience studies for offshore aggregate, mineral and hydrocarbon resources and environmental protection.
- Expedite, on a national or broadly regional basis, analysis of Canada's sedimentary basins.
- Continue communications initiatives to raise public awareness of the applications and importance of all kinds of geoscience knowledge.

NOTE: Groundwater Statement

- Because groundwater resources are not the responsibility of all provincial and territorial geological surveys, GSC is advised to consult with each province and territory on this important matter.

March, 1999

PROVINCIAL GEOLOGISTS MEDALIST 1999

A. Bruce Ryan

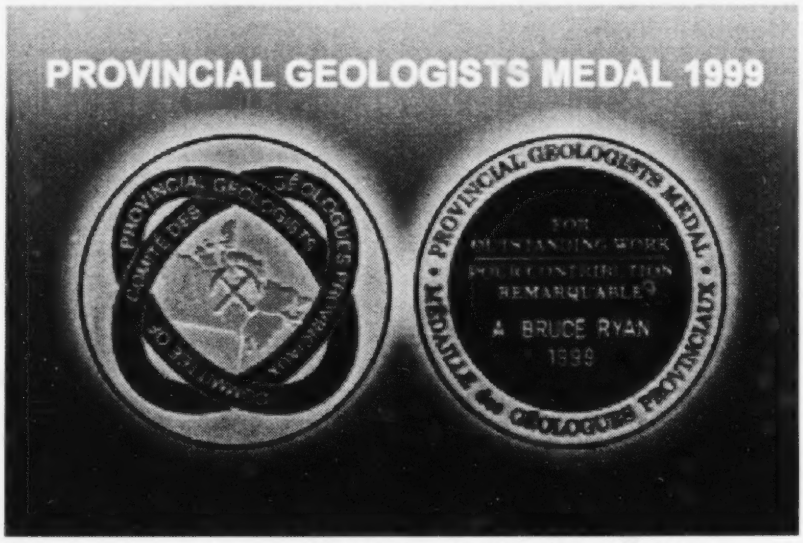
Bruce Ryan (left) receiving the Provincial Geologists Medal from the Honourable Donald MacKinnon, Co-chair of the Mines Ministers Conference and Minister of Development for P.E.I.

The Provincial Geologists Medal is awarded to recognize major contributions in the area of geoscientific research and related developments or applications that serve to meet the mandate of Canada's provincial and territorial Geological Surveys. Each Survey may nominate a candidate each year, and an external national selection committee chooses the recipient from the pool of nominees. For 1999, the winner of the inaugural Provincial Geologists Medal was A. Bruce Ryan. The citation below was read by Dr. Andy Fyon (OGS), Chairman of the Committee of Provincial Geologists, during the medal presentation at the Energy and Mines Ministers Conference in Charlottetown, P.E.I., September 13, 1999.

CITATION

Bruce Ryan, a senior geoscientist with the Geological Survey of Newfoundland and Labrador, Newfoundland Department of Mines and Energy, has made profound contributions to our understanding of the geological evolution of Labrador. Most notably, this has been through his diligent work in four geological terranes: the Makkovik geological province of central Labrador; the ancient 2.5 billion-year old rocks of northern Labrador; the boundary zone between the Nain and Churchill geological provinces; and the granite-like rocks of the so-called Nain Plutonic Suite.

Bruce was also instrumental in the recognition of the ancient Torngat mountain-building episode of northern Labrador, and the fundamentally important manner in which it brought together the Nain and Churchill geological provinces to form part of the Canadian Shield. His meticulous mapping in the Nain Plutonic Suite defined its full internal complexity, including the breakthrough recognition that it contains both 2-billion-year-old and 1.3-billion-year-old rocks. This work also resulted in the discovery and definition of a hitherto unrecognized rock unit, which would later be found to host the world-class Voisey's Bay deposit. In fact, Bruce's landmark 1990 geological map of the Nain region, together with a remarkably prescient model for the origin of the Voisey's Bay nickel–copper–cobalt deposit, formed the foundation for the exploration rush that followed the discovery.



Obverse and reverse images of the 1999 Provincial Geologists Medal.

Bruce Ryan has well elucidated his science through a large number of Geological Survey and international journal publications, as well as through numerous technical lectures. In 1996 he was presented with the Geological Association of Canada's Boldy Award for his paper on the Voisey's Bay deposit. That same year he was selected again by the Geological Association of Canada as its Robinson Distinguished Lecturer for 1996-1997, and he undertook a very successful 24-stop national lecture tour. Bruce has also promoted the public awareness of geoscience at all levels, including public lectures, newspaper articles and television and radio interviews.

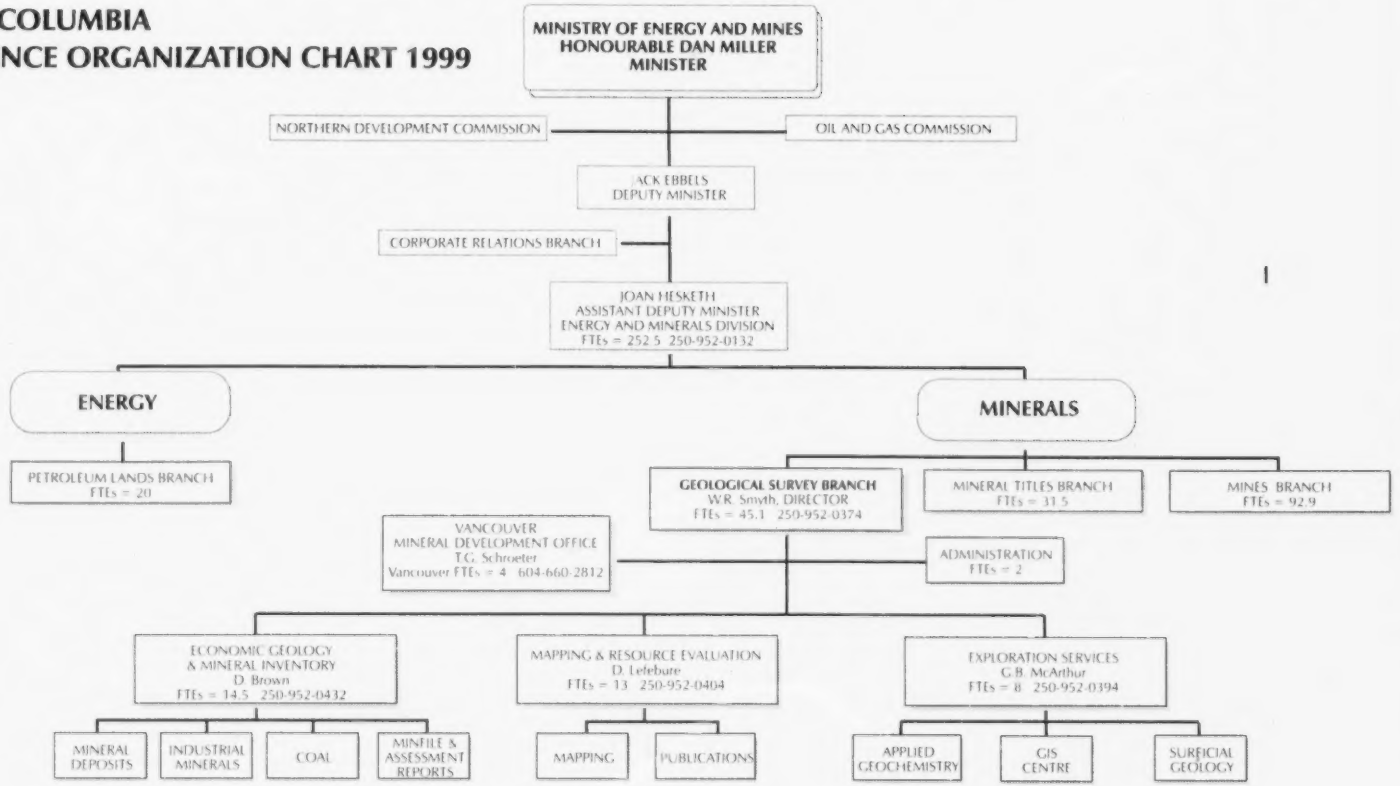
In closing, listen to Professor Tony Naldrett of the University of Toronto in a letter supporting Mr. Ryan's nomination: "*These qualities, coupled with his inquisitive, logical mind, his unselfish enthusiasm for geology and his courage in adversity make him, in my view, one of the most exceptional Canadian geologists active today*"; And Mr. Colin McKenzie, Vice President of Voisey's Bay Nickel Co.: "*Bruce's mapping and studies have laid the geological framework for understanding the setting and controls of mineralization at Voisey's Bay*"; Finally, Professor Tony Morse of the University of Massachusetts: "*Scholar, artist, servant of society, Bruce Ryan is the quintessential Provincial Geologist*".

Ladies and gentlemen, for these accomplishments and personal attributes, Bruce Ryan richly deserves the inaugural Provincial Geologists Medal.

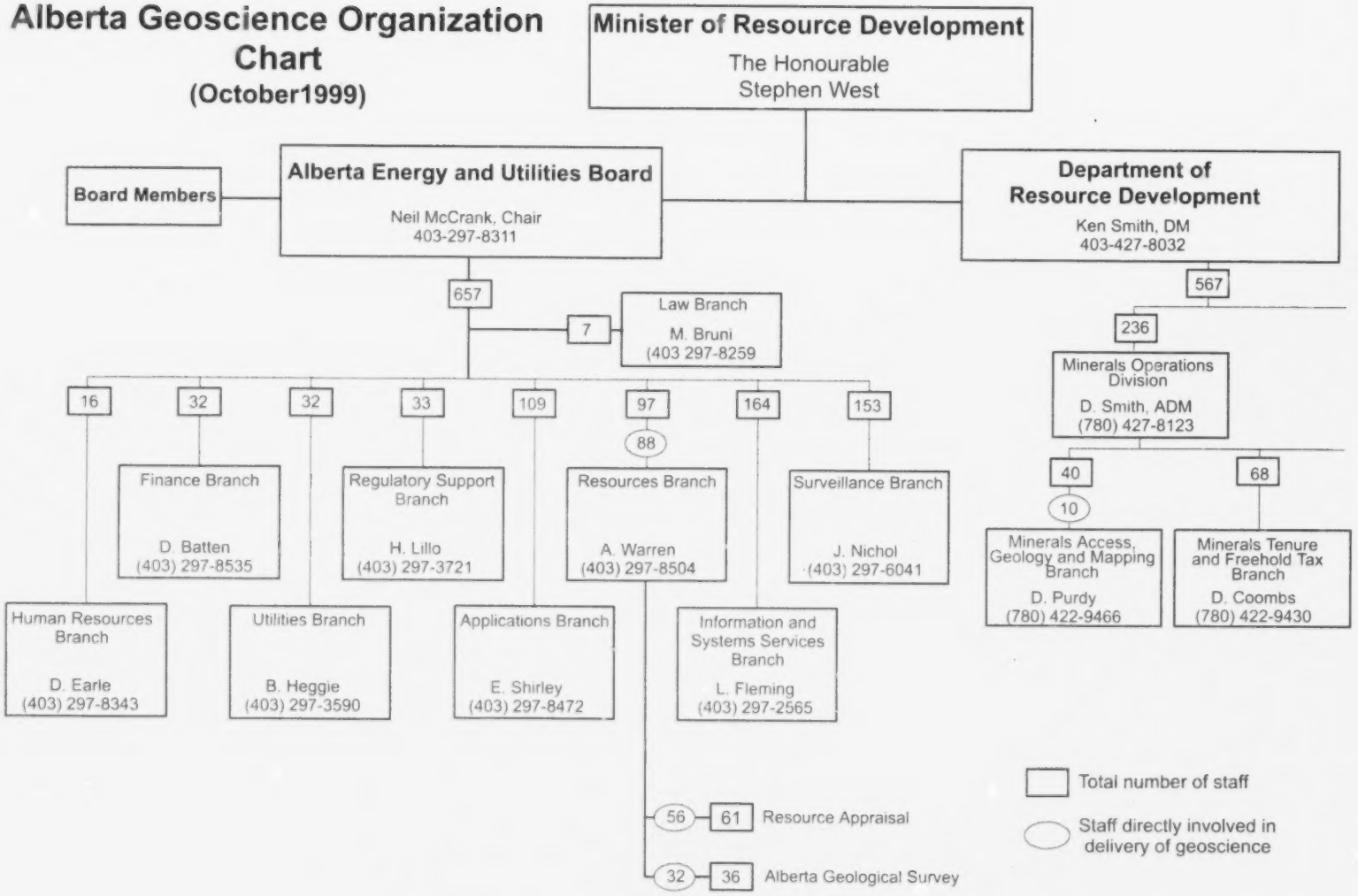
GEOSCIENCE ORGANIZATION CHARTS - 1999

Each Provincial and Territorial government in Canada has developed its own organization structure for conducting geoscientific survey and research work. Some provinces have what is formally called a Geological Survey, but in most jurisdictions the main elements of the geological survey function are embraced in one or more Branches or Divisions of provincial Mines/Energy/Natural Resources departments. The following organization charts are set out in standard format to help clarify access to geoscience services for potential clients. The charts contain reference to the lines of reporting for the various units in each hierarchy, the staffing associated with each separate jurisdiction, and the names and telephone numbers of key individuals in each system.

BRITISH COLUMBIA GEOSCIENCE ORGANIZATION CHART 1999

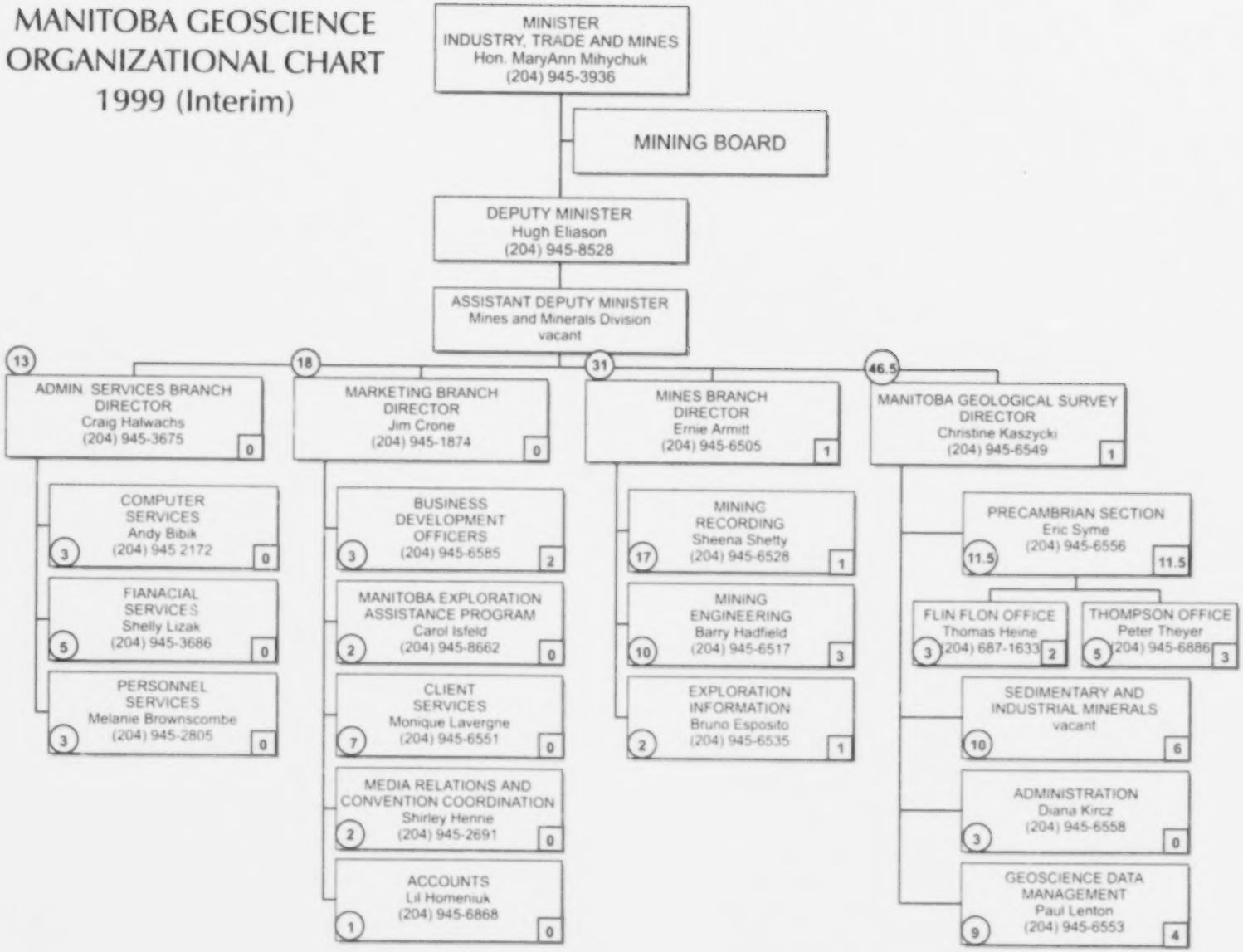


Alberta Geoscience Organization Chart
(October1999)



Saskatchewan Geoscience Organization Chart
Saskatchewan Energy and Mines
Hon. Eldon Lautermilch
Minister
(306) 787-0615
Ray Clayton
Deputy Minister
(306) 787-2496
Saskatchewan Research Council
Jim Hutchinson
President/CEO
(306) 933-5402
Environment Branch
Bryan Schreiner
Director
(306) 933-5495
Mineral Exploration Branch
Ranga Ranganathan
Director
(306) 933-8185
2
Petroleum & Natural Gas
Bruce Wilson
Exec. Director
(306) 787-2591
Exploration and Geological Services
George Patterson
Exec. Director
(306) 787-2560
Economics
Dan McFadyen
Asst. Deputy Minister
(306) 787-2523
5
Support Services
Carol Brown
Manager
(306) 787-2578
18.5
11
Mines Branch
Pam Schwann
Director
(306) 787-2584
Petroleum Geology Branch
Chris Gilboy
Director
(306) 787-2573
Finance & Administration
Don Koop
Asst. Deputy Minister
(306) 787-3624
15.5
Northern Geological Survey
Gary Delaney
Director
(306)787-1160
4.3
Summer Student Program

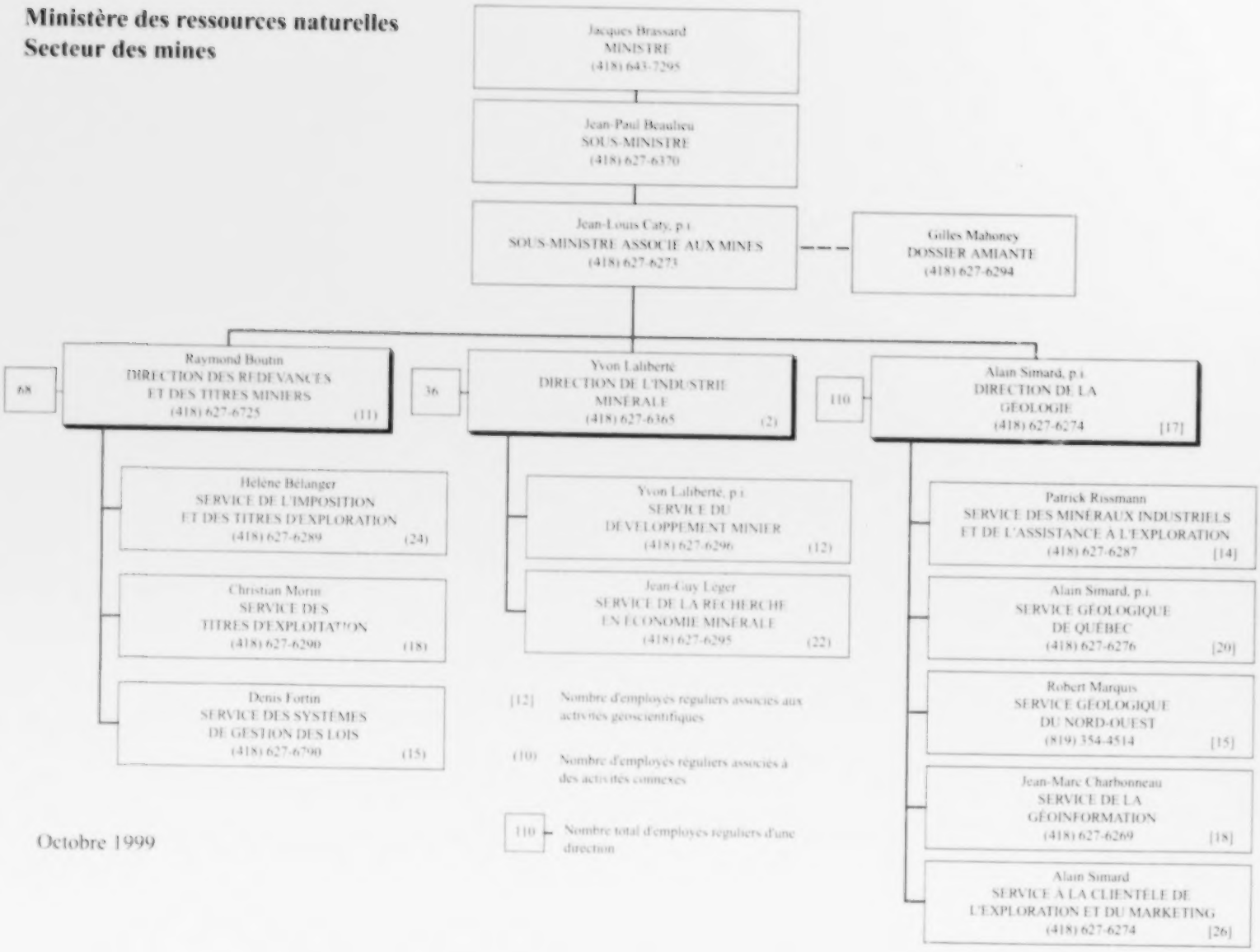
MANITOBA GEOSCIENCE ORGANIZATIONAL CHART 1999 (Interim)



Ontario Mines and Minerals Divisions
Organization Chart
Minister of Northern Development & Mines
Honorable Tim Hudak
Deputy Minister
Northern Development & Mines
Cameron Clark
Assistant Deputy Minister
Northern Development & Mines
John Gammon
OGS Precambrian Geoscience
Andy Fyon
705-670-5924
34.5
OGS Sedimentary Geoscience
Cameron Baker
705-670-5902
19.5
OGS Resident Geologists
Hial Newsome
705-670-5955
43.5
Data Services
Gianfranco Merlino
705-670-5840
8
Mining Lands
Ron Gashinski
705-670-5840
5
Mines Group
Dick Cowan
705-670-5784
1
Information Service
Marc Couse
705-670-5829
6
Geoscience Laboratories
Rob Campbell
705-670-5643
25
LEGEND
30 Number of staff directly associated with Geoscience Activities

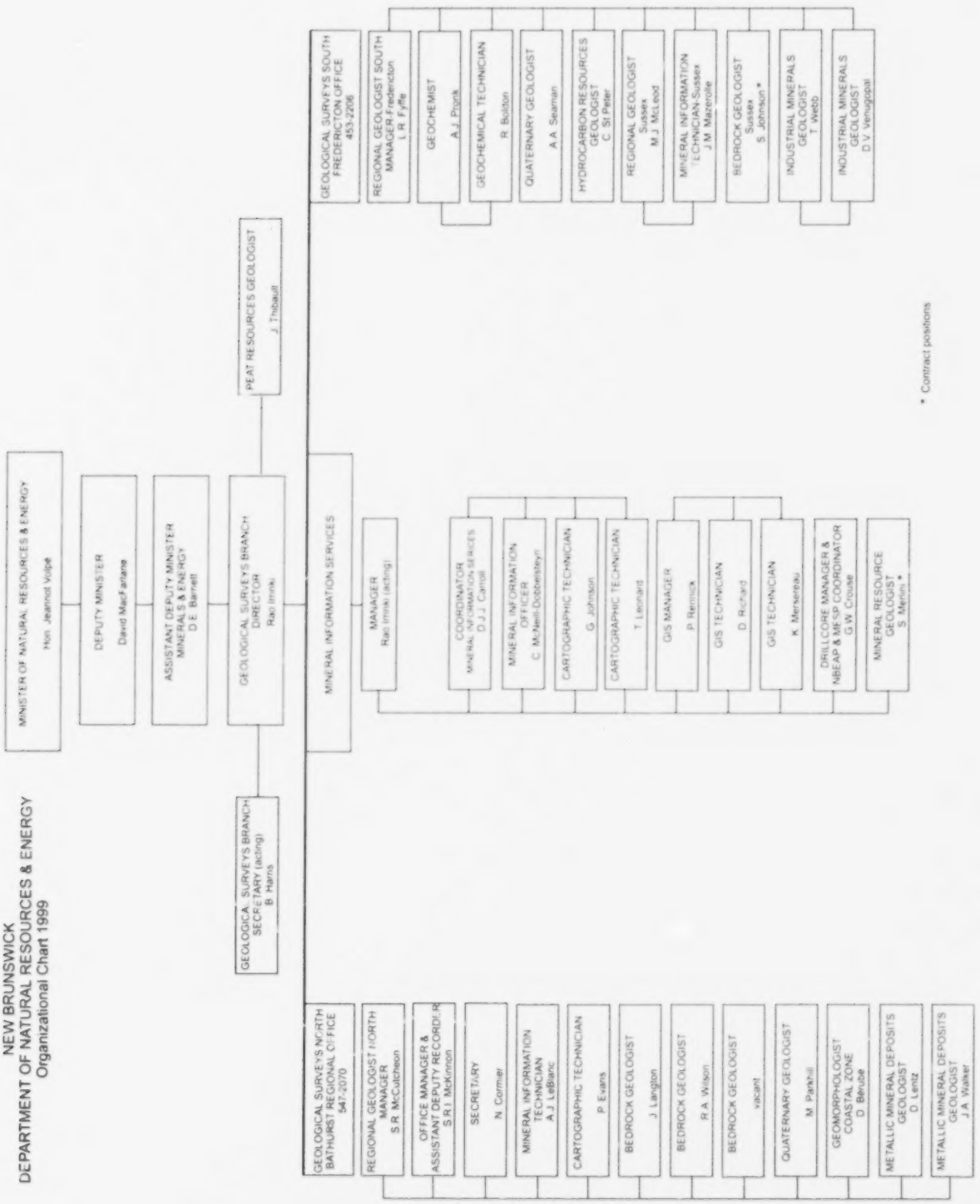
Quebec Geoscience Organization Chart 1999

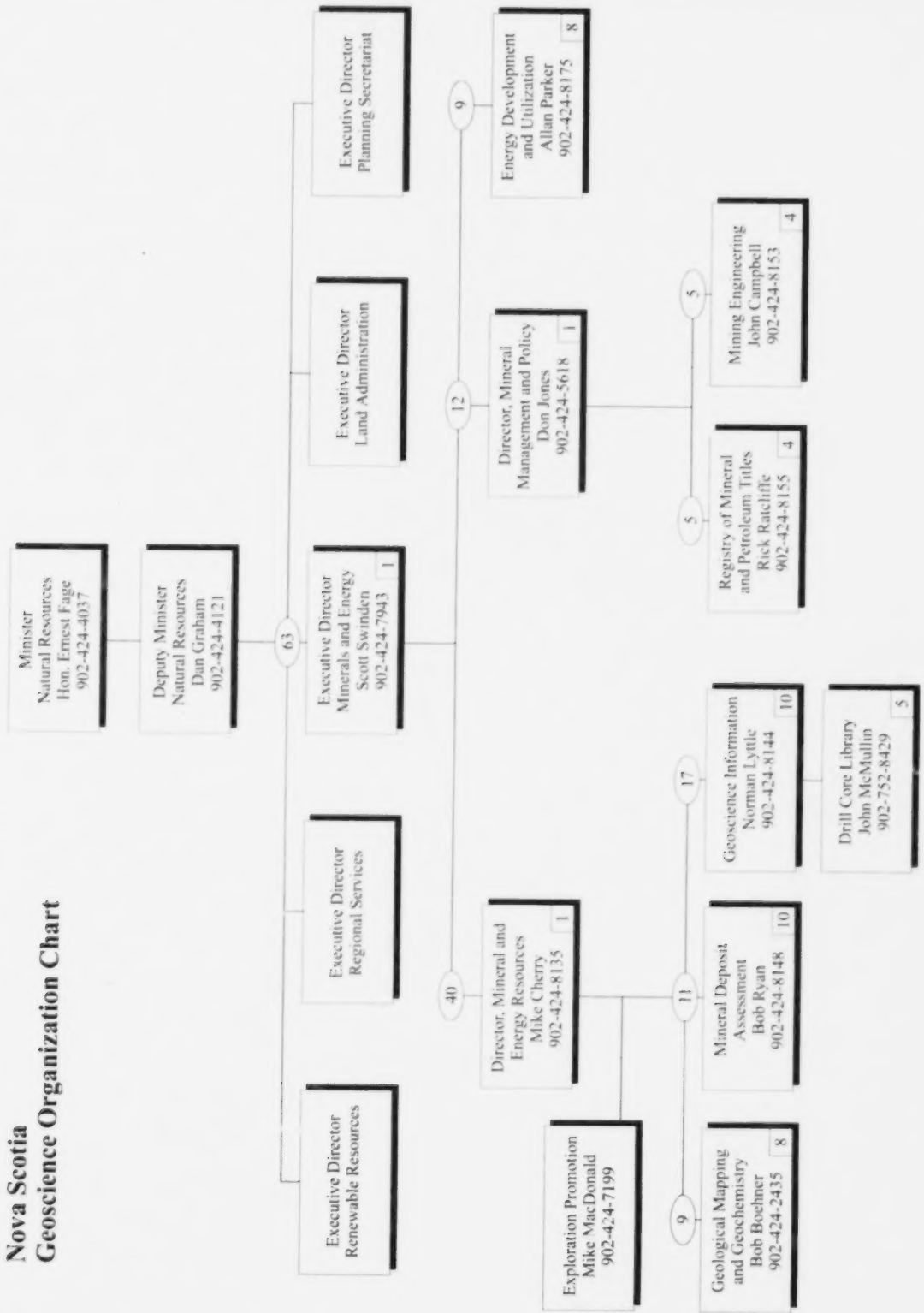
Ministère des ressources naturelles
Secteur des mines



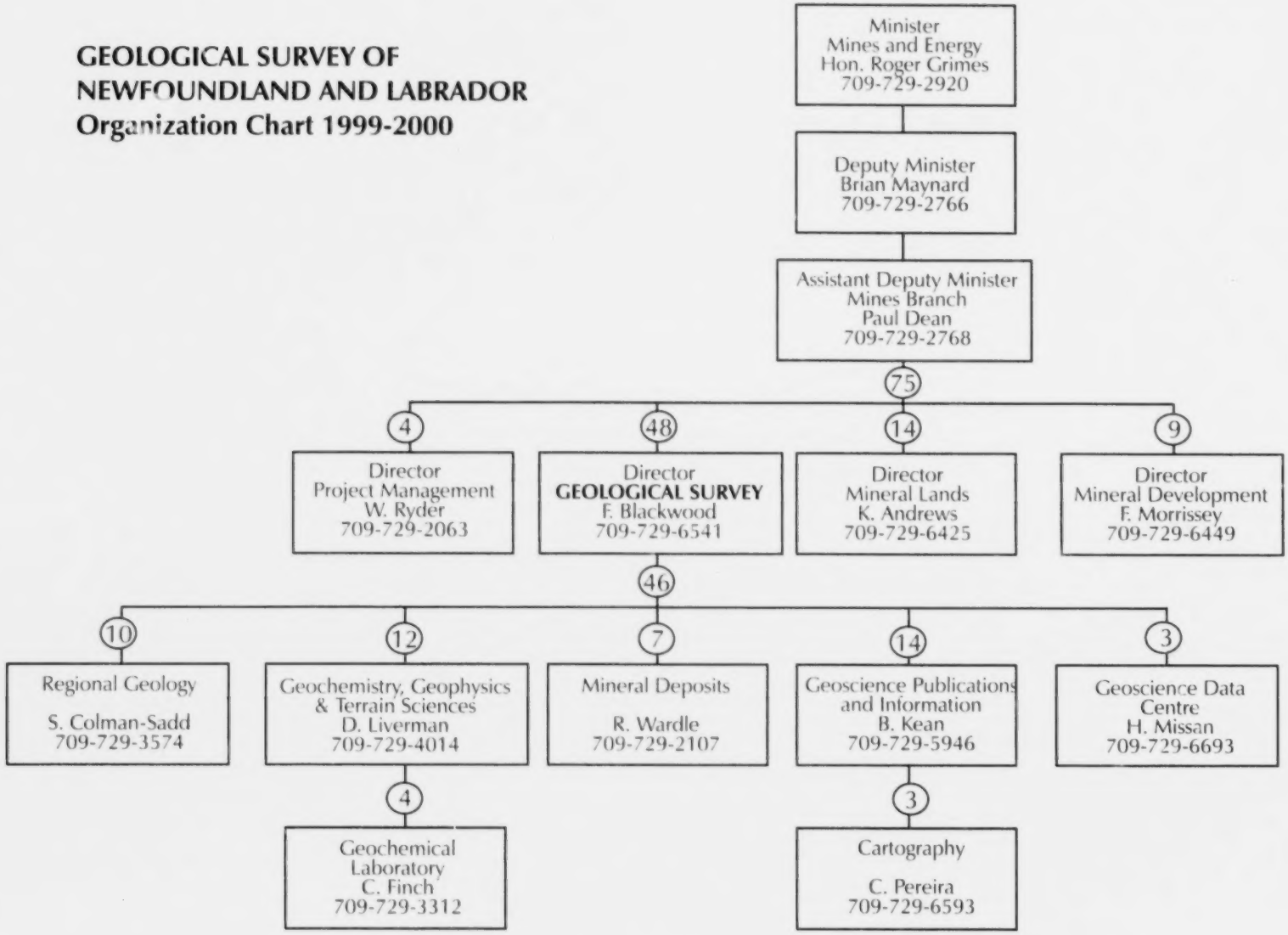
Octobre 1999

New Brunswick Geoscience Organization Chart 1999



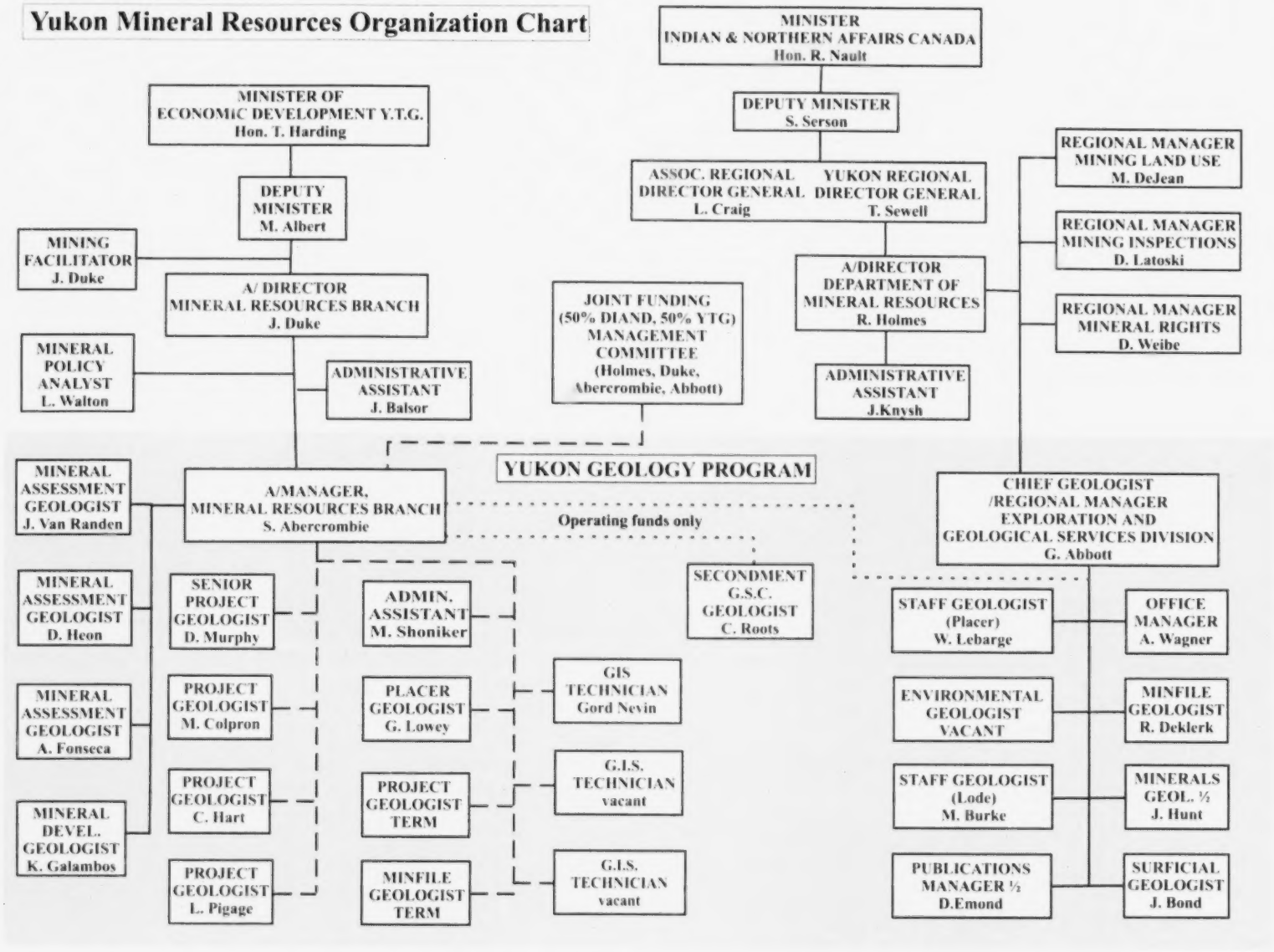

Nova Scotia
Geoscience Organization Chart
Minister
Natural Resources
Hon. Ernest Fage
902-424-4037
Deputy Minister
Natural Resources
Dan Graham
902-424-4121
63
Executive Director
Planning Secretariat
Executive Director
Land Administration
Executive Director
Minerals and Energy
Scott Swinden
902-424-7943
1
Executive Director
Regional Services
Executive Director
Renewable Resources
9
Energy Development
and Utilization
Allan Parker
902-424-8175
8
12
Director, Mineral
Management and Policy
Don Jones
902-424-5618
1
5
Mining Engineering
John Campbell
902-424-8153
4
5
Registry of Mineral
and Petroleum Titles
Rick Ratcliffe
902-424-8155
4
40
Director, Mineral and
Energy Resources
Mike Cherry
902-424-8135
1
11
17
Geoscience Information
Norman Lyttle
902-424-8144
10
Drill Core Library
John McMullin
902-752-8429
5
Exploration Promotion
Mike MacDonald
902-424-7199
Mineral Deposit
Assessment
Bob Ryan
902-424-8148
10
9
Geological Mapping
and Geochemistry
Bob Boehner
902-424-2435
8

GEOLOGICAL SURVEY OF NEWFOUNDLAND AND LABRADOR
Organization Chart 1999-2000



DIAND NWT Geology Division
Chief Geologist & Regional Manager Carolyn Relf
Administrative Coordinator Brendan Norman
District Geologist Steve Goff
District Geologist Karen Gochnauer
District Geologist Jason Sharp
Diamond Geologist John Armstrong
Resource Appraisal Geologist Velma Sterenberg
Archives Geologist Joe Heimbach
Archives Technician Rita Mogyorosi
Database Manager Beth Sage
Database Geologist Karen MacFarlane
Database Geologist Donna Schreiner
Database Geologist Chris Bianchi
DIAND
Resources, Wildlife and Economic Development
Minerals, Oil and Gas Division
Director Doug Matthews
Director's Secretary Joanne Tsetta
Mineral Policy Specialist Jackie Cusveller
Manager Oil and Gas vacant
Resource Assessment Geologist Deb Archibald
Resource Economist Calvin Brackman
Resource Assessment Geologist Adrienne Jones
Research Analyst vacant
Project Geologist vacant
Resource Data Specialist Anna Soininen
C.S. Lord Northern Geoscience Centre
Co-managers: Carolyn Relf and Jackie Cusveller
Project Geologist Valerie Jackson
Project Geologist Scott Cairns
Project Geologist Hendrik Falck
GIS Specialist Doug Irwin
Prospector Training Geologist Diane Baldwin
RWED

Yukon Mineral Resources Organization Chart



PROVINCIAL GEOLOGICAL SURVEY EXPENDITURES 1998-1999 FINAL & 1999-2000 PRELIMINARY

Provincial/Territorial Geological Survey Expenditures 1998-1999

Province/Territory	Survey Expenditures**	% of Total	1999 Provincial Mineral Production*	Survey Expenditures as percentage of Provincial Mineral Production	Area Prov/Terr km^2	Survey Expenditures $/km^2$	Population 1996	Survey Expenditures per Capita
BRITISH COLUMBIA	$4,131,630	7.9%	3,046,937,000	0.14%	947,800	$4.36	4,023,100	$1.03
ALBERTA	$2,076,499	4.0%	26,671,286,000 +	0.01%	661,190	$3.14	2,964,689	$0.70
SASKATCHEWAN	$2,463,337	4.7%	2,214,208,000	0.11%	652,330	$3.78	1,027,780	$2.40
MANITOBA	$3,943,700	7.5%	1,020,573,000	0.39%	649,950	$6.07	1,143,509	$3.45
ONTARIO	$10,993,200	21.0%	5,573,825,000	0.20%	1,068,580	$10.29	11,513,808	$0.95
QUEBEC	$16,621,600	31.7%	3,395,910,000	0.49%	1,540,680	$10.79	7,345,390	$2.26
NEW BRUNSWICK	$2,887,155	5.5%	853,071,000	0.34%	73,440	$39.31	754,969	$3.82
NOVA SCOTIA	$2,492,321	4.8%	378,005,000	0.66%	55,490	$44.91	939,791	$2.65
PRINCE EDWARD ISLAND	n/a	n/a	3,410,000	n/a	5,660	n/a	137,980	n/a
NEWFOUNDLAND	$3,223,289	6.2%	1,008,273,000	0.32%	405,720	$7.94	541,000	$5.96
YUKON	$1,322,657	2.5%	225,302,000	0.59%	483,450	$2.74	30,633	$43.18
NORTHWEST TERRITORIES	$2,245,300	4.3%	548,768,000	0.41%	3,426,320	$0.66	41,606	$53.97
Canadian Total:	**$52,400,688**	**13%**	**$1,782,343,000**	**2.940%**	9,970,610		30,464,255	

** Source: Natural Resources Canada: Mineral Industry Review 1997 Revised estimates*

*** Does not include expenditures on Industry Grant Programs (e.g., Prospectors Assistance) see Table 2 for details on grants.*

Note: Comparisons between jurisdictions are difficult due to the variety of budget/program components and methods of reporting data.
Expenditures column includes a total of A-base funds and other funds available to the geological surveys.
Provincial mineral production figures include metals, non-metals, structural materials and coal.
+ Alberta figures also include natural gas, natural gas by-products and crude oil.

Provincial/Territorial Industry Grant Programs
1998-1999 Final

Province/Territory	Prospectors Assistance	Mineral Exploration Assistance	Total
BRITISH COLUMBIA	$500,000	$0	$500,000
ALBERTA	n/a	n/a	n/a
SASKATCHEWAN	n/a	n/a	n/a
MANITOBA	$125,000	$3,000,000	$3,125,000
ONTARIO	$2,000,000	$0	$2,000,000
QUEBEC	$1,405,000	$5,326,100	$6,731,100
NEW BRUNSWICK	$50,000	$350,000	$400,000
NOVA SCOTIA	$83,140	$0	$83,140
NEWFOUNDLAND	$172,919	$0	$172,919
YUKON	$122,998	$174,034 *	$297,032
NORTHWEST TERRITORIES	$75,000	$0	$75,000
Totals:	**$4,534,057**	**$8,850,134**	**$13,384,191**

** Yukon Target Evaulations*

Provincial Geological Survey Expenditures
1999-2000 Preliminary Estimates

Province/Territory	Survey Expenditures	% of Total	1999-2000 Industry Grant Programs
BRITISH COLUMBIA	$4,007,000	7.50%	$500,000
ALBERTA	$2,297,995	4.30%	$0
SASKATCHEWAN	$2,550,000	4.77%	$0
MANITOBA	$3,943,700	7.38%	$3,125,000
ONTARIO	$11,377,000	21.29%	$4,000,000
QUEBEC	$15,363,900	28.75%	$5,366,300
NEW BRUNSWICK	$2,723,600	5.10%	$350,000
NOVA SCOTIA	$2,556,565	4.78%	$190,000
NEWFOUNDLAND	$3,315,600	6.20%	$2,100,000
YUKON	$2,806,550	5.25%	$467,600
NORTHWEST TERRITORIES	$2,505,000	4.69%	$180,000
Canadian Total:	**$53,446,910**	**100.00%**	**$16,278,900**

Mineral Activities	Funding Agency	# of Projects	Permanent Positions	Casual Positions	Salaries	Operational	Total $
Bedrock geological surveys	GSB*	9	10.00		$862,204	$229,035	$1,091,239
Geochemical surveys	GSB	1	3.10		$226,781	$50,598	$277,379
Surficial geology surveys	GSB	1	2.40		$254,863	$60,901	$315,764
Mineral deposit studies	GSB	4	6.50		$557,212	$78,853	$636,065
Mineral inventory compilations	GSB	1	3.00		$185,700	$21,000	$206,700
Aggregrate Inventory	GSB	2	2.00	1.00	$156,347		$156,347
Industrial mineral studies	GSB		2.25		$183,051	$19,430	$202,481
Vancouver regional office	GSB		4.00		$201,872	$60,000	$261,872
District Geologists	Mines Br.		4.00		$309,043	$50,767	$359,810
Sub Total		**18**	**33.25**	**1.00**	**$2,628,030**	**$519,817**	**$3,147,847**
Energy Activities							
Coal		1	1.25		$95,211	$15,000	$110,211
Sub Total		**1**	**1.25**	**0.00**	**$95,211**	**$15,000**	**$110,211**
Other Activities							
Terrain Map Library	FRBC		*2.00*		*$128,000*	*$325,000*	*$453,000*
Mineral Resource Assessment	CRII		*1.00*		*$90,000*	*$50,000*	*$140,000*
Assaying Costs	GSB		0.50		$30,602	$44,745	$75,347
Admin/Management	GSB		8.00		$406,608	$173,046	$579,654
Sub Total		**0**	**8.50**	**0.00**	**$437,210**	**$217,791**	**$655,001**
Miscellaneous							
Publications	GSB		1.00		$74,363	$14,000	$88,363
Assessment Report Audit	GSB		1.50		$91,708	$9,000	$100,708
Research grants	GSB					$29,500	$29,500
Sub Total		**0**	**2.50**	**0.00**	**$166,071**	**$52,500**	**$218,571**
Total Mineral Survey Activities ***(GSB Base Budget)***		**19**	**45.50**	**1.00**	**$3,326,522**	**$805,108**	**$4,131,630**

Funding Agencies Abbreviations:

** GSB - Geological Survey Branch; Mines Br. - Mines Branch; CRII - Corporate Resource Inventory Initiative; FRBC - Forest Renewal BC; JEPP/UBC - Joint Emergency Preparedness Planning and University of BC*

Province: Alberta 1998-1999

	Agency	Funding	Projects	Person Years		Salaries ($)		Operating
				Perm.	Casual	Perm.	Casual	Expenditures
Mineral Activities								
Geochemical Surveys	EUB	EUB	1	1.72	0.33	$ 117,724.17	$ 8,816.03	$ 40,264.87
Bedrock Geology	EUB	EUB	2	1.94	0.05	$ 119,871.51	$ 1,296.90	$ 15,659.92
Mineral Investigations (Field)	EUB	1	1	0.75	0.6	$ 53,977.37	$ 16,061.54	$ 132,600.85
Industrial Minerals	EUB	EUB	1	1.41	0.71	$ 90,934.56	$ 15,230.80	$ 43,800.96
Core Repositories	EUB	EUB	1	0.19	0.0	$ 10,772.90	$ -	$ 2,530.16
Energy Activities								
Oil, Gas, and Coal	EUB	1	3	4.89	0.52	$ 258,607.11	$ 10,255.55	$ 145,036.19
Other Activities								
Hydrogeology	EUB	EUB	2	1.7	0.33	$ 104,059.25	$ 8,816.03	$ 3,944.75
Geoscience Information System	EUB	EUB	1	1.25	0.0	$ 68,664.91	$ -	$ 59,701.36
Chief's Office / Administration	EUB	EUB	2	4.16	0.19	$ 278,622.61	$ 4,379.82	$ 125,658.67
Laboratories	EUB	EUB	1	0.14	0.0	$ 8,178.34	$ -	$ 2,530.15
Miscellaneous								
Library	EUB	EUB	1	0.33	0.0	$ 13,902.33	$ -	$ 44,109.88
Publication / Data Sales	EUB	EUB	2	2.35	0.0	$ 153,251.60	$ -	$ 36,845.01
Other	EUB	EUB	2	1.12	0.0	$ 70,507.56	$ -	$ 9,885.05
Totals				**21.95**	**2.73**	**$ 1,349,074.22**	**$ 64,856.67**	**$ 662,567.82**

1 = EUB / WEPA

Province: SASKATCHEWAN 1998-99

	# Projects	Positions #py's Permanent	Non-permanent	Salaries Permanent	Non-permanent	Operational $	Total $
Mineral Activities							
Bedrock Geology Survey	7	4.2	3	$301,238.00	$146,295.00	$161,878.00	$609,411.00
Mineral Investigations	2	1	0	$68,080.00	$0.00	$23,160.00	$91,240.00
Mineral Deposit Invertory	1	1	0.3	$53,235.00	$0.00	$0.00	$53,235.00
Industrial Mineral Studies	1	1	0.3	$57,349.00	$6,512.00	$16,259.00	$80,120.00
District Geologists	n/a	2	0	$130,202.00	$0.00	$0.00	$130,202.00
Core Depositories	1	0	0.3	$0.00	$8,023.00	$10,651.00	$18,674.00
Mineral Resource Assessment	1	1	1	$51,663.00	$29,206.00	$5,253.00	$86,122.00
Energy Activities							
Oil/gas	n/a	8	2	$276,000.00	$54,000.00	$7,000.00	$337,000.00
Core Depositories	1	4	2	$171,000.00	$25,000.00	$23,000.00	$219,000.00
Subsurface analysis	3	6	2	$261,000.00	$72,000.00	$16,000.00	$349,000.00
Other Activities							
Chief's Office/Administration	n/a	2	0	$115,000.00	$0.00	$70,559.00	$185,559.00
Miscellaneous							
Publications	n/a	2.5	0	$105,000.00	$0.00	$52,000.00	$157,000.00
Information/Assessment Files	n/a	0	1	$0.00	$34,187.00	$2,277.00	$36,464.00
Other - GIS/Computerization	n/a	1	1	$60,816.00	$32,812.00	$16,682.00	$110,310.00
Grand Total	**17**	**33.7**	**12.9**	**$ 1,589,767.00**	**$ 375,223.00**	**$ 388,037.00**	**$ 2,463,337.00**

PROVINCE: MANITOBA - 1999-2000

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS OR FACILITIES	PERMANENT SMY	CASUAL/ TERM SMY	SALARIES PERMANENT $	SALARIES CASUAL $	OPERATING EXPENDITURES $
MINERAL ACTIVITIES								
Bedrock Geology Surveys	MGS	MAN	13	12.00	3.23	755.8	73.0	204.0
Geochemical Surveys	MGS	MAN	4	2.00	0.31	145.3	14.2	237.2
Surficial Geology Surveys	MGS	MAN	5	2.00	1.09	119.7	21.1	18.0
Geophysical Surveys	MGS	MAN	1	1.00	-	67.2	-	7.0
Mineral Investigations (Field)	MGS	MAN	8	2.00	0.04	113.5	2.0	40.0
Mineral Deposit Analysis/Inventory	MGS	MAN	2	2.00	-	115.9	-	2.5
Industrial Minerals	MGS	MAN	1	1.00	0.13	61.2	4.6	2.5
District Geologists	MGS	MAN	4	4.26	-	229.9	-	40.5
Core Repositories	MGS	MAN	6	0.00	-	0.0	0.0	8.5
ENERGY ACTIVITIES								
Coal/Peat	-	-	-	-	-	-	-	-
Oil & Gas	-	-	-	-	-	-	-	-
Core Repositories	-	-	-	-	-	-	-	-
Subsurface Analysis	-	-	-	-	-	-	-	-
OTHER ACTIVITIES								
Environment/Land Use	MGS	MAN	1	-	-	-	-	0
Hydrology	MGS	MAN	-	-	-	-	-	-
Laboratories	MGS	MAN	1	4.00	0.05	147.5	2.3	2[illegible]
Miscellaneous Activities	MGS	MAN	7	8.00	0.00	199.9	-	1[illegible].4
Charts Office/Administration	MGS	MAN	11	7.00	0.21	299.6	11.8	615.6
MISCELLANEOUS DETAILS								
Library	-	-	-	-	-	-	-	-
Publications	-	-	-	-	-	-	-	-
Prospectors Assistance	-	-	-	-	-	-	-	-
Information/Assessment Files	-	-	-	-	-	-	-	-
Research Grants	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-
TOTALS	-	-	88	45.26	5.25	2455.5	129.0	1359.2

MGS - MANITOBA GEOLOGICAL SERVICES

Province: Ontario 1998/99

	Funding Agency	No. of Projects or Facilities	Staff Permanent (person/yrs)	Staff Contract (person/yrs)	Salaries	Operating Expenditures *(incl. Benefits)*	Totals
Mineral Activities							
Bedrock Geology Surveys	MNDM	13	19.5	7.0	$1,459,300	$865,000	$2,324,300
Geochemical Surveys	MNDM	3	2.0	4.0	260,000	186,000	$446,000
Surficial Geology Surveys	MNDM	4	5.0	3.0	399,000	92,000	$491,000
Mineral Investigations (field)	MNDM	2	3.0	1.5	207,000	84,000	$291,000
Mineral Deposit Analysis and/or Inventory	MNDM	1	0.5		31,600	25,800	$57,400
Industrial Minerals	MNDM	4	4.0	1.5	271,000	165,800	$436,800
Resident & District Geoogists	MNDM	10	43.5		1,785,200	765,000	$2,550,200
Core Repositories	MNDM	5	2.0		95,000	51,000	$146,000
Geophysical Surveys	MNDM	6	1.0		63,100	87,500	$150,600
Other Activities							
Geoscience Assessment	MNDM		5.0		241,000	70,300	$311,300
Environment/Land Use	MNDM		1.0		62,100	32,000	$94,100
Laboratories	MNDM		17.0	8.0	1,050,800	749,000	$1,799,800
Miscellaneous Details							
Library	MNDM		1.0		35,300	29,400	$64,700
Publications	MNDM		5.0		226,000	242,000	$468,000
Data Services	MNDM		8.0		471,000	891,000	$1,362,000
Totals			**117.5**	**25.0**	**$6,657,400**	**$4,335,800**	**$10,993,200**
Industry Grant Programs							
Prospector's Assistance*	MNDM/OPAP					2,000,000	2,000,000

*Program administered by Mines Group

MNDM - Ministry of Northern Development & Mines

OPAP - Ontario Prospector's Assistance Program

Province: QUÉBEC 1998-1999

Programmes	Financement	Nb de Projets	Employés			Salaires			Dépenses d'opération	Total
			Permanents	Occasionnels	Contrat	Permanents	Occasionnels	Contrat		
			(équivalent à temps complet)			$			$	$
Activités géominières:										
* Cartographie géologique	MRN	19	26.5	11.5	9.4	1,374,200	1,180,300	511,050	5,114,450	8,180,000
*Levés/études géochimiques	MRN		1.5			82,000			20,400	102,400
*Levés/études géophysiques	MRN	10	1.0		0.1	58,700		17,100	1,800	77,600
*Levés/études géologie de surface	MRN	1	1.0	0.5		58,700	7,600		34,100	100,400
* Recherche en métallogénie (terrain)	MRN	19	6.4	4.8	2.7	386,900	155,700	193,270	315,030	1,050,900
* Gîtologie	MRN	1	0.5			30,300			1,700	32,000
* Étude de potentiel minéral	MRN	4	0.1	0.7	0.6	6,700	20,000	35,000	10,200	71,900
* Minéraux industriels	MRN	6	2	0.4		117,400	7,600		17,900	142,900
* Cévologues résidents	MRN	7	25.4	3.6		700,600	113,800		326,800	1,141,200
Autres activités:										
* Administration/Bureau du géologue en chef	MRN	2	24.1			914,500	2,800		415,100	1,332,400
Divers:										
* Promotion et marketing	MRN	8	1.9	2.5		196,500	6,100		58,500	461,100
* Publications	MRN	6	10.2			293,700	336,700		117,200	745,600
* Information	MRN	6	7			344,600	219,700		172,000	736,300
* Autres (SIGÉOM-GIS)	MRN	8	1.5			360,300	159,200		1,927,400	2,446,900
Sous total:		97	109.8	43	13	5,123,100	2,209,500	756,420	8,512,580	16,623,600
Assistance financière à l'exploration minière	MRN	384	4.2	2		157,400	101,100		6,472,600	6,731,100
Grand total:		**481**	**113**	**45**	**13**	**5,280,500**	**2,310,600**	**756,420**	**15,005,180**	**23,352,700**

MRN = Ministère des Ressources naturelles

Province: New Brunswick 1998-1999

	No. of Projects	Staff			Salaries	Operating	Total
		Perm.	Casual	Contract			
Geological Surveys Branch							
Bedrock Geology	5	4.0	0.6	1.0	$287,500	$87,100	$374,600
Surficial Geology and Till Geochemistry	6	5.0	0.4		248,700	167,800 [2]	416,500
Mineral Deposits	4	2.5	0.6	1.0	193,600	161,100	354,700
GIS and Digital Technology	4	3.5			128,200	43,200	171,400
Regional Geologists	2	7.0	0.3		299,100	75,500	374,600
Drill Core	3	1.0			54,000	58,900 [3]	112,900
Editorial (Communications Branch)	1	1.0			55,955	5,900	61,855
Director's Office	1	1.0			65,200	7,800	73,000
Geophysics (Airborne)	2					409,400 [1]	409,400
Industrial Minerals	3	3.0			167,800	25,400	193,200
Publications Education	5	5.0			191,000	78,600	269,600
Oil, Gas, Oil Shale	1	1.0	0.2		62,700	12,700	75,400
Total	**37**	**34.0**	**2.1**	**2.0**	**$1,753,755**	**$1,133,400**	**$2,887,155**

[1] Includes $400,000 funding from N.B. Regional Development Corporation

[2] Includes $100,000 funding from N.B.Regional Development Corporation

[3] includes $25,000 funding from N.B. Regional Development Corporation
$25,000 Department Capital

Province: NOVA SCOTIA 1998-1999

	Survey Research Agency	Funding Agency	No. of Projects or Facilities	Employees*		Operating* Expenditures	Salaries*	Totals*
				Permanent	Casual			
Mineral Activities								
Bedrock Geology Surveys	MERD	NSDNR	4	5.0	1.5	$38,383	$280,650	$319,033
Geochemical Surveys	MERD	NSDNR	1	2.0		$13,707	$100,174	$113,881
Surficial Surveys	MERD	NSDNR	1	2.0	0.5	$20,011	$116,837	$136,848
Geophysical Surveys								
Mineral Investigations (Field)	MERD	NSDNR	2	2.5	0.5	$35,055	$141,697	$176,752
Mineral Deposit Analysis/Inventory	MERD	NSDNR	2	2.5	0.5	$27,064	$134,555	$161,619
Industrial Minerals	MERD	NSDNR	2	2.5	0.5	$20,142	$135,191	$155,333
District Geologists	RSB	NSDNR						
Core Repositories	MERD	NSDNR	1	6.5	0.3	$40,400	$269,800	$310,200
Energy Activities								
Coal/Peat	MERD	NSDNR	2	2.5	0.5	$22,101	$148,204	$170,305
Oil and Gas	PD	NSDNR						
Core Repositories	PD	NSDNR						
Subsurface Analysis	PD	NSDNR						
Other Activities								
Environmental / Land Use	MERD	NSDNR	2	2.5		$5,000	$125,536	$130,536
Hydrology	DOE							
Laboratories								
Miscellaneous Activities - Mineral Promotion	MERD	NSDNR	n/a	1.0		$20,000	$57,828	$77,828
Chief Geologist's Office/Administration	MERD	NSDNR	n/a	2.0		$45,000	$106,042	$151,042
Miscellaneous Details								
Library	PS	NSDNR	n/a					
Publications	MERD	NSDNR	n/a	2.5	0.5	$40,587	$101,788	$142,375
Public Awareness/Prospectors Training	MERD	NSDNR	n/a	2.5	0.5	$9,885	$141,121	$151,006
Information/Assessment Files	MERD	NSDNR	n/a	1.5		$5,000	$70,528	$75,528
Research Grants								
Informaton Technology	MERD	NSDNR	n/a	3.5	1.5	$29,365	$190,670	$220,035
Totals				41.0	6.8	$371,700	$2,120,621	$2,492,321

* = FTEs and budget data provided for MERD only

MERD = Mineral and Energy Resources Division

RSB = Regional Services Branch

PD = Petroleum Directorate

PS = Planning Secretariat

DOE = Department of Environment

PROVINCE: NEWFOUNDLAND 1998-1999

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	No of PROJECTS/ FACILITIES	SMY Permanent[1]	SMY Casual	PERMANENT $	SALARIES CONTRACT[1]	CASUAL $	OPERATING EXPENDITURES	TOTALS
MINERAL ACTIVITIES										
Bedrock geology surveys	GSNL	NDME	9	9	3.5	$456,820	-	$48,936	$355,143	$860,899
Geochemical surveys	GSNL	NDME	4	3	1	$160,901	-	$21,753	$136,607	$319,261
Surficial geology surveys	GSNL	NDME	3	3	.5	$141,970	-	$12,622	$21,446	$176,038
Geophysical surveys	GSNL	NDME	1	1	-	$47,520	-	-	$1,000	$48,520
Mineral investigations (field)	GSNL	NDME	4	3	.25	$168,910	-	$10,323	$125,878	$305,111
Mineral deposit analysis and/or inventory	GSNL	NDME	1	3	-	$119,812	-	-	$2,000	$121,812
Industrial minerals	GSNL	NDME	2	2	.5	$106,987	-	$11,267	$31,964	$150,218
District geologists	-	-	-	-	-	-	-	-	-	-
Core repositories	MLD	NDME	1	2	.5	$90,516	-	$5,522	$44,900	$140,938
ENERGY ACTIVITIES										
Coal/Peat	-	-	-	-	-	-	-	-	-	-
Oil & Gas	EB	NDME	1	20	-	$809,900	$181,000	-	$305,300	$1,296,200
Core Repositories	-	-	-	-	-	-	-	-	-	-
Subsurface Analysis	-	-	-	-	-	-	-	-	-	-
OTHER ACTIVITIES										
Environment/Land Use	MLD	NDME	1	5	.25	$195,944	-	$4,409	$32,700	$233,053
Hydrology	-	-	-	-	-	-	-	-	-	-
Laboratories	GSNL	NDME	1	4	-	$141,555	-	-	$52,440	$193,995
Miscellaneous Activities	-	-	-	-	-	-	-	-	-	-
Director's Office/ Admin	GSNL	NDME	2	6	-	$222,251	-	-	$159,000	$381,251
MISCELLANEOUS DETAILS										
Library	GSNL	NDME	1	3	- *	$54,973	-	-	$5,314	$60,287
Publications/ Cartography	GSNL	NDME	3	7	-	$241,091	-	-	$31,400	$272,491
Information/ Assessment files	GSNL	NDME	2	4	-	$180,292	-	-	$23,814	$204,106
Research Grants	-	-	-	-	-	-	-	-	-	-
Information Technology	GSNL	NDME	1	-	-	-	-	-	$129,300	$129,300
TOTALS			37	75	6.5	**$3,139,442.00**	**$181,000.00**	**$114,832.00**	**$1,458,206.00**	**$4,893,480.00**

Notes: *GSNL - Geological Survey of Newfoundland and Labrador*
MLD - Mineral Lands Division
MB - Mines Branch
EB - Energy Branch
NDME - Newfoundland Department of Mines and Energy
1 - includes long-term temporary staff
** - includes $ 23,642 (Opening Doors Program)*

TOTAL GEOLOGICAL SURVEY ACTIVITIES 1998-1999 (GSNL).... 3,223,289

TOTAL GEOLOGICAL SURVEY ACTIVITIES 1999-2000 (GSNL).... 3,315,600

TERRITORY: YUKON 1998 -1999

	Survey Research Agency	Funding Agency	Projects	Positions		Salaries	Operating Expenditures
				Perm	Casual		
Mineral Activities							
Bedrock Geological Surveys	YTG	INA/YTG	3	3	1.5	$268,789	$203,511
	GSC	INA/YTG/GSC	1	1	0		$5,000
Mineral Deposit Studies	INA	INA/YTG	1	1	.25	$79,518	$30,500
	YTG	INA/YTG	1	1	0.5	$101,475	$57,825
Geological Compilation	GSC	INA/YTG	2	0	0		$40,500
Surficial Geology	YTG	INA/YTG	1	1	.25	$79,800	$47,800
	INA	INA/YTG	2	2	.75	$143,766	$109,900
	GSC	INA/YTG/GSC	1	0	0		$10,000
	YTG	INA/YTG	1	0	0		$6,000
Geochemical Research	GSC/AC	INA/YTG	1	0	0		$80,000
Mineral Resource Assessments	YTG	YTG	2	1	0.75	$97,000	$103,000
Mineral Deposit Inventory	INA	INA	1	0.75	0	$43,972	$11,000
	YTG	INA/YTG	2	0	0		$60,000
District Geologists	INA	INA	1	0.75	0	$43,972	$20,000
Core Repositories	INA	INA	1	0.25	0.25	$24,657	$14,800
Energy Activities							
Oil & Gas Resource Assessments	YTG/NEB	YTG	2	0	0		$200,000
Other Activities							
Administration	YTG	INA/YTG	1	1	0	$46,535	$120,201
	YTG	YTG	1	1	0	$65,000	$22,300
	INA	INA	1	1.5	0	$100,524	$60,000
Library	INA	INA	1	0	0		$15,000
Cartography/Publications	INA	INA	1	0.5	0.25	$31,594	$10,000
	YTG	INA/YTG	2	2	0	$82,000	$90,320
Assessment Files	INA	INA	1	0.25	0	$14,657	$5,000
Total				**18**	**4.5**	**$1,223,259**	**$1,322,657**

Agency Abbreviations:
YTG - Government of Yukon; INA - Indian and Northern Affairs Canada; GSC - Geological Survey of Canada;NEB -National Energy Board

Territory: Northwest Territory 1998-1999

	1998-1999 NWT and Nunavut (DIAND and GNWT)	1999-2000 NWT only (DIAND and GNWT)	salary *1998-1999*	salary *1999-2000*
Mineral Activities				
Bedrock geology surveys	$402,000	$235,000	$215,000	$145,000
Geochemical surveys	$88,000	n/a	$20,000	n/a
Surficial geology surveys	n/a	n/a	n/a	n/a
Gephysical surveys	n/a	n/a	n/a	n/a
Mineral investigations (field)	$62,500	$250,000	$80,000	$160,000
mineral deposit analysis and/or inventory	$98,000	$183,000	$236,000	$370,000
Industrial minerals	n/a	n/a	n/a	n/a
District Geologists	n/a	$60,000	$426,000	$288,000
Core repositories	$9,300	$4,000	$0	$0
Enery Activities				
Coal/Peat	n/a	n/a	n/a	n/a
Oil & Gas	n/a	n/a	n/a	n/a
Core repositories	n/a	n/a	n/a	n/a
Subsurface analysis	n/a	n/a	n/a	n/a
Other Activities				
Environment/Land Use	n/a	$200,000	$30,000	$110,000
Hydrology	n/a	n/a	n/a	n/a
Laboratories	n/a	n/a	n/a	n/a
Miscellaneous Activities	n/a	$35,000	$75,000	$75,000
Chief Geologist's Office/Administration	$60,000	$100,000	$80,000	$80,000
Miscellaneous Details				
Library	$2,000	$2,000	$35,000	$35,000
Publications	$14,300	$15,000	$42,000	$42,000
Information/Assessment files	$5,500	$8,000	$25,000	$25,000
Research Grants	$239,700	$83,000	n/a	n/a
	$981,300	**$1,175,000**	**$1,264,000**	**$1,330,000**

GEOLOGICAL PROGRAM HIGHLIGHTS

British Columbia Program Highlights 1999

Overview

Base funding for the British Columbia Geological Survey (GSB) remained essentially unchanged in 1999-2000 at $4.066 million. As in previous years the survey program was targeted at meeting government objectives in areas of economic development and land and resource management. The base budget was supplemented by $277,000 from other government agencies for projects in land use planning. A major new project was begun in 1999 under the auspices of the National Mapping Program, NATMAP. The Ancient Pacific Margin Project is a 5-year joint project with the GSC and the Yukon Geology Program to re-map and assess the mineral potential of this poorly understood belt.

Program Highlights For 1999

Economic Development Program

The Branch's economic development field program concentrated on under-explored frontier areas and on areas with established mining infrastructure. Highlights include:

- ✔ Initiation of the Ancient Pacific Margin NATMAP project, a joint venture with the Geological Survey of Canada, universities and industry. Bedrock mapping, surficial mapping and geochemical programs demonstrate that favourable Yukon-Tanana stratigraphy, with potential for volcanogenic massive sulphides, extends from the Yukon into British Columbia. Mineral deposit studies in comparable rocks in central British Columbia were also completed.
- ✔ Geological evaluation of favourable areas in the southern part of the province with potential for plutonic-related gold deposits, such as Pogo and Fort Knox.
- ✔ Initiation of a mapping and mineral deposit project in the Ecstall Belt within the Coast Plutonic Complex to more clearly identifying the controls on VMS mineralization.
- ✔ A reconnaissance assessment for copper and gold-rich iron oxide deposits in British Columbia, such as Candelaria and Olympic Dam.
- ✔ Geologic mapping in the Mt. McCusker-Robb Lake area was completed as part of the GSB commitment to the Foreland Belt NATMAP project.
- ✔ Continuing coal quality and washability studies designed to better understand the nature of coal deposits, the province's most valuable commodity in 1999.
- ✔ Continuation of Gemstone Project. Recent prospector discoveries of gem quality iolite and garnet in the Slocan Valley and opal near Vernon and Houston point out the potential for gemstones in BC.

The Branch continued to work on upgrading the geoscience databases for the province, including those for mineral occurrences (MINFILE), assessment reports (ARIS) and regional geochemical data (RGS). Client access to these and other datasets continues to improve as the Ministry's web site evolves. Clients can now view, plot and perform GIS type analysis of the Branch's georeferenced spatial information sets. A pilot project has been initiated to provide industry assessment reports over the Internet.

The Branch completed a compilation project to identify favourable areas for Eskay Creek type volcanogenic massive sulphide deposits in the Province. These deposits are very attractive because of their enhanced precious metal contents and polymetallic nature. Eskay Creek has a mineable reserve of 1.45 Mt grading 57.7 g/t Au and 2493 g/t Ag as of January 1999 and is the fifth largest silver producer in the world. Twenty two areas were identified based on a combination of geology, known occurrences and geochemical indicators. A well attended workshop on this topic was delivered in November 1999 in co-operation with the Mining Exploration Group and the BC and Yukon Chamber of Mines.

Resource Management Program

The Branch received $153 000 from the Government's Corporate Resource Inventory Initiative(CRII) to complete two detailed min-

eral potential studies in Coast Ranges and Queen Charlotte Islands in support of ongoing Land and Resource Management Planning. Mineral occurrences were examined and key areas were covered with regional geochemical sampling surveys.

The Terrain Stability and Soils projects, funded by Forest Renewal BC, continued during 1999. The GSB audits digital terrain data submitted by forest companies in compliance with the Forest Practices Code and makes this data available over the Internet. Terrain and soil maps are increasingly being used in mineral exploration, for example as an aid in interpreting geochemical surveys. These products are also valuable for land-use planning.

Prospector Assistance

The Government continued to issue grants to encourage prospectors to conduct grassroots exploration in the Province. Fifty one prospectors received grants worth more than $430 000 in 1999 and spent more than 2500 prospecting days in the field. A number of new discoveries have been reported.

Assayers Certification

The program to examine and certify assayers in BC was transferred in 1999 to the British Columbia Institute of Technology under the direction of a Assayers Advisory Board, with representation and supporting funding from industry and the Ministry.

Alberta Program Highlights 1999

Highlights

The provincial government has recognized the potential significance of a minerals industry within Alberta. As a result a Minerals Strategy has been created for the purposes of enhancing knowledge about the minerals potential of the province as well as a framework for a more active minerals exploration industry.

Base funding was set at $2.5M as the parent organization, the Alberta Energy and Utilities Board (EUB) tightened spending as part of its overall restructuring. However, an additional $0.75 million dollars has been targeted for expanding the minerals program within the AGS which supplements its current budget.

The survey relocated to larger premises in March 1999 with a resulting increase in workspace area and additional offices for anticipated staffing increases related to the expanded minerals program.

The AGS participated in hearings established by the Energy and Utilities Board, which deal with applications by petroleum companies for the extraction of hydrocarbon resources. The AGS provided expert advice in two hearings during the past year. The AGS also responds to queries and requests from industry and government.

There is ongoing development of an information dissemination policy due to increasing publication costs and the move towards providing maps, reports and data in digital form via the Internet.

An agreement between the AGS and the GSC was signed in July 1999 based on the 1996 Intergovernmental Geoscience Accord. The agreement outlines principles of cooperation and collaboration between the two surveys.

Program

Strategic Directions

- ✔ Improve Alberta's geological knowledge, with a target of increasing the investment in mapping and geoscience to $10 million a year from provincial and federal funding sources.
- ✔ Develop innovative approaches for delivering geological and mineral assessment information to exploration and mining companies.

Minerals Strategy

During the 1992-95 Mineral Development Agreement (MDA), the provincial and federal governments invested $8.4 million in mapping and other information services for the mineral sector in Alberta. This resulted in a substantial increase in exploration. However, recent spending for mapping programs in Alberta remains low. In 1998, the EUB invested $2.5 million and the federal government $0.5 million in mapping activities in Alberta. Achieving the goal of $10 million per year would require significant additional commitments from the federal and provincial governments

Alberta's Throne Speech for 1999/2000 committed the Alberta Government to develop a non-energy mineral policy, to streamline the administration of mining regulations and to increase geological information knowledge base. The Province has committed additional funding to the AGS to increase geologic mapping and geoscience studies beginning in 1999. The expanded minerals program will deliver maps, reports and databases needed by the mineral industry.

The Alberta Chamber of Resources (ACR) has identified needs and generated interest in mineral development. The mineral exploration industry has identified kimberlites in the Buffalo Head Hills and Birch Mountains areas. Heavy minerals exploration is currently underway in the Pelican Mountains area and the Chinchaga area is being investigated for its metallic mineral potential.

The Alberta Ministry of Resource Development is currently receiving feedback on a document that outlines a vision and strategic directions for mineral development.

Mineral Resources Program

The mineral resources program focuses on studies of metallic/ non-metallic minerals including diamonds, industrial minerals, sand and gravel.

Current Projects

- ✔ Reconnaissance studies for diamond and metallic minerals:
- ✔ Sub-Cretaceous unconformity NE Alberta
- ✔ Geochemistry of Fernie Group shales
- ✔ regional and detailed bedrock and stream sediment sampling
- ✔ Diamond exploration methodologies
- ✔ Wabasca Quaternary geology
- ✔ Industrial mineral and aggregate maps for Kakwa-Wapiti and Fort McMurray areas
- ✔ Peerless Lake (NTS 84B) Quaternary Geology Project identifying areas of abnormal concentration of kimberlite indicator minerals
- ✔ Rock Island Lake Region Quaternary Geology project (NTS 84).
- ✔ Tiny diamond indicator minerals (chromite and garnet) have been identified in bedrock samples from the Wapiti study area.
- ✔ Mapping in the Cypress Hills region. The region spans the Cretaceous-Tertiary boundary and has been disturbed through slumping, glacial tectonics and a possible meteorite impact. The Whitemud and Ravenscrag Formations are of economic importance as they supply raw materials for the last remaining brick operation in western Canada.

Projects funded by the Western Economic Partnership Agreement:

- ✔ Mineral Resource Infrastructure Study, Northern Alberta.

Energy Resources Program

Studies of geological factors affecting the distribution and recovery of fossil fuel resources, groundwater availability and quality and disposal of fossil fuel industry waste.

Current Projects

- ✔ A joint project with the Geological Survey of Canada produced a report on the Regional Analysis of the Ardley Coal Zone, Alberta Canada, for Coalbed Methane Production (CBM) and CO_2 sequestration.
- ✔ Work supporting an Alberta Research Council led project on CO_2 sequestration and enhanced CBM production continues.
- ✔ Oil sands reservoir and aquifer characterization in Athabasca area with the development of a unified facies classification scheme for the oil sands deposits. Seismic studies have been used to characterize features of the basin and underlying estuarine channels in cooperation with the University of Calgary.
- ✔ Additional bedrock map of the Wapiti area. Seismic studies in the foothills of the area have identified east and west-verging faults and detachment zones.
- ✔ Support to the Alberta Department of Energy and the Energy and Utilities Board
- ✔ A major update on the distribution and thickness of salt within the Middle Devonian Elk Point Group in the Western Canada Sedimentary Basin was completed.
- ✔ Projects funded by the Western Economic Partnership Agreement:
- ✔ Evaluation of groundwater resources in the Athabasca area where recovery of bitumen from oil sands is expected to grow in the next decade.
- ✔ Regional scale suitability of the Alberta basin for CO_2 sequestration in geological media.

Program Support

Administrative, financial, clerical, equipment, assets and communications support, core information technology infrastructure, maintenance of AGS data holdings and maintenance of the Mineral Core Research Facility.

Information technology support

The information technology environment of the AGS is being overhauled. Standardization of hardware and office automation technology is being phased into the AGS over the next two

years. The survey is moving from a diverse group of hardware and operating system platforms (VAX-VMS, MacIntosh, Windows 95/98/NT) to a standard configuration of Windows NT on Intel-based workstations and servers.

Laboratory services

Over the 1998/99 period 893 samples were processed for the Aggregate, Mineral Infrastructure Study, and Quaternary projects.

Geoscience Information Dissemination

Collection, organization, dissemination and communication of internal and external geoscience information

Current Projects

- ✔ Establish and maintain new product standards.
- ✔ Implementation of the Data Legacy project which is designed to archive previous AGS information in a fully searchable index via the internet through a metadata catalogue.
- ✔ Re-development of the AGS Web site including interactive map viewing.
- ✔ Improve and expand electronic products and delivery
- ✔ On-going development and maintenance of an effective client feedback system
- ✔ Maintenance of the geoscience library function

Metallic and Industrial Mineral Assessment

The amount of mineral exploration assessment work filed, continued to increase in Alberta in 1999. To the end of August, 1999 a total of 23 work reports were filed (25 in 1998) with a combined value of $22 158 942 ($18 508 911 in 1998) and covering an area of 6 085 253 hectares (2 408 638 hectares in 1998). The commodities sought were diamond, gold, lime, and alumina.

Saskatchewan Program Highlights 1999

Funding for the Saskatchewan Geological Survey remained unchanged in 1999-2000 at almost $2.5 million inclusive of professional and support staff salaries, summer student hiring, and operational expenditures. Most projects were a continuation of those undertaken in 1998-99. Additional enhancements to the province's geoscience program were achieved through cooperative ventures with the Geological Survey of Canada, Saskatchewan universities and the mineral exploration industry.

Precambrian Geology

Three Saskatchewan Geological Survey and one Geological Survey of Canada mapping parties were active in the fourth year of The La Ronge – Lynn Lake Bridge Project. The purpose of this major investigation is to:

- ✔ See completion of 1:20000 map coverage of the Paleoproterozoic La Ronge Domain to the Saskatchewan – Manitoba border;
- ✔ Examine the relationships of major crustal units accreted to the Rae-Hearne Craton in a north-south transect on Reindeer Lake; and
- ✔ Evaluate mineral potential. Three mapping projects were undertaken in the Rae Province to the north of Lake Athabasca.

This is the second year of a long-term initiative to better understand the tectonic history and mineral potential of a generally poorly mapped area. Two mapping parties completed the third year of a structural and stratigraphic transect of the Wollaston Domain. This project has potential implications for uranium exploration in the Athabasca Basin and is a cooperative venture with the uranium industry and the Universities of Regina and Saskatchewan. The Saskatchewan Geological Survey also supported a graduate thesis investigation of stratigraphic and structural relationships in the Deilmann Open pit at the Key Lake uranium mine. Work continued on an investigation of the structural context of gold mineralization in the vicinity of the Byers Fault Zone of the Central Metavolcanic Belt in the La Ronge Domain. Again this year, projects were augmented by undergraduate and postgraduate thesis projects at the Saskatchewan and Alberta universities.

Industrial Minerals

Investigation of sodium sulphate deposits in southern Saskatchewan continued. Isotopic tracers are being evaluated as tools for quantifying groundwater inputs to these actively forming deposits. A better understanding of deposit genesis should lead to enhancement of their value as resources. Collection of brine chemistry data from oil well samples continued. Water-isotope data are expected to facilitate better understanding of basin history and fluid migration history. Geochemical data from this study may add substance to previous studies that suggested that Saskatchewan subsurface brines have potential as feedstock for a diversified chemical industry.

Petroleum Geology

Projects focusing on a) Cretaceous Colorado Group rocks, b) Lower Paleozoic strata, and c) production of annotated digital and hard copy 1:2 000 000-scale structure and isopach maps of the province's main Phanerozoic stratigraphic units, remain in progress. Preliminary hard-copy versions of Lower Paleozoic formations in this map series are expected to be released in the near future for industry feed-back prior to final compilation of the digital product which will comprise seven maps. Joint studies with the Geological Survey of Canada, Manitoba Energy and Mines, and the Geology Departments of Universities of Alberta, Regina, Saskatchewan and Western Ontario continue to be productive. Summaries of many of these and other geoscientific research projects were published in the inaugural issue of part one of the department's two-part Saskatchewan Geological Survey Summary of Investigations.

As a direct result of the low price of oil, drilling activity in the province and hence use of the Subsurface Geological Laboratory for core and

sample examinations were slow for the first four months of 1999 giving the slowest start to the year since 1992. Drilling activity picked up in May and since then has remained at provincial boom levels. This increase will impact on the processing and provision of well information by the Petroleum Geology Branch and ways of trying to keep up with the influx of data are being examined.

Computerization

Digital product and processing capability continues to develop not only in the Saskatchewan Geological Survey but also throughout the Saskatchewan Department of Energy and Mines. GIS software is being used to aid in map production and geological interpretation. All current Precambrian geology maps included with the Summary of Investigations are produced using AutoCAD and FieldLog on digital bases provided by SaskGeomatics. The maps and associated data files are available digitally. The revised 1:1 000 000-scale Geological Map of Saskatchewan is complete and available in hard copy and on a CD-ROM which includes various related datasets viewable in a GIS format. The Geological Atlas of Saskatchewan CD-ROM version 2.0 (1999) was released at the 1999 Open House and includes several new datasets as well as updates and enhancements of datasets included on the first release. Mineral disposition maps have been converted to digital format and are being tested for upcoming release. Assessment work area maps and mineral deposit information is available digitally.

The Saskatchewan Geological Survey is represented on the Canadian Geoscience Knowledge Network (CGKN) Implementation Committee whose purpose is to investigate methods to establish computerized links to all government geological surveys and provide national and international access to Canadian geoscience knowledge.

The Internet site for the department will continue to see the addition of information items:

http://www.gov.sk.ca/enermine

Mineral Resource Assessments

Regional mineral resource assessments (MRAs), of known and potential mineral and petroleum resources, are being done in response to Saskatchewan's Representative Areas Network program to preserve ecological diversity, and regional integrated land use planning processes. Appraisals at a scale of 1:250 000 have been completed for most of the northern portion of the province and for selected areas in the south. MRAs completed in the last year include NTS map sheets 64D, 64E, 64M, 73O, 74A, 74B, 74F, 74H, 74K, 74N, and 74O. The ultimate goal is to complete MRA coverage for the entire province. Developed by the Ontario Geological Survey, the mineral assessment methodology is qualitative and integrates, through a structured process, geoscience and mineral and petroleum exploration and development data with assessment criteria derived from descriptive mineral deposit models. Participation of the mineral and petroleum industries is a critical component of the process. Digital geological compilation and mineral resource assessment maps are the main products of the assessments. These will be upgraded to a GIS format over time.

Exploration and Development

Grass roots mineral exploration expenditures are estimated to be $29 million in 1999, compared to $30 million in 1998 and $43 million in 1997. These figures reflect a downward trend in exploration expenditures for all mineral commodities. These numbers exclude uranium, base metal and gold test mining, and underground exploration costs of $261 million in 1998 and estimated expenditures of $233 million in 1999. Mineral dispositions covered 2.99 million hectares at the end of 1997 rising to 3.34 million hectares at the end of 1998. By the end of July 1999, however, ground under disposition had shrunk to 3.14 million hectares.

In 1998, expenditures on uranium exploration decreased to $22 million from $27 million in 1997. This marks the first break in an upward trend that began in 1993. The downward trend is expected to continue in 1999 when it is estimated that $16 million will be spent on uranium exploration. 1998 was a transition year in uranium mining. This was marked by the de-

velopment and commissioning of a new generation of mines in the Athabasca Basin as reserves at historical producers were depleted and some of those sites prepared for decommissioning. Some highlights:

- ✔ At McLean Lake (70% Cogema Resources Inc.; 22.5 % Denison Mines; and 7.5% OURD Canada), final approval of operating licenses was obtained and production began in late June 1999. Initial ore is from the Jeb Pit, site of the tailing management facility, and subsequent ore will come from the Sue Pit currently under development.
- ✔ At McArthur River (70% Cameco Corporation and 30% Cogema Resources Inc), the world's largest high-grade uranium deposit, construction proceeded on schedule towards a fourth quarter 1999 startup that is contingent on obtaining all of the necessary operating licenses.
- ✔ At Cigar Lake (50% Cameco Corp.; 37% Cogema Resources Inc.; 8% Indemitsu; 5% TEPCO), the second largest, high-grade uranium deposit in the world, conditional approval for development was received. It is anticipated that production will commence in late 2001 or early 2002.
- ✔ Operations at Cluff Lake (100% Cogema) are to be suspended indefinitely as of December 31, 2000.
- ✔ At Key Lake (83% Cameco Corp. and 17% Cogema Resources Inc), where the ore has been mined out, the mill is being retrofitted to handle higher grade McArthur River ore.

Although the potential for the discovery of new gold orebodies is high, the current depressed price for gold has had a severe effect on exploration with nine companies expecting to expend a total of only $2 million in 1999. The Seabee gold mine, of Claude Resources Inc., produced a record 60 200 ounces of gold in 1998 and is again expected to produce about 60 000 ounces in 1999. Since its opening in November 1991 to the end of June 1999 the Seabee gold mine produced almost 400 000 ounces of gold.

Base metal exploration, involving 9 companies, continued in Shield and sub-Phanerozic programs mostly west and southwest of Flin Flon. Exploration expenditures decreased to about $4 million in 1998, but are expected to rise to $7 million in 1999. Major developments on the base metal front included:

- ✔ Hudson Bay Mining and Smelting Co. Ltd. proceeded with the final phase of development of the Konuto Lake copper mine near Denare Beach at an estimated cost of $27.5 million. Full production was achieved during the summer of 1999.

Partnership Programs

Region	Program	Participants
Flin Flon/Snow Lake	NATMAP	GSC, SEM, Univs.
(complete)	CAMIRO	Industry, GSC, Univs.
Lynn Lake/Leaf Rapids	MOU	HBED
	Collaboration	U of M, GSC
Superior Boundary Zone		
Thompson Nickel Belt	CAMIRO	Industry, GSC, Univs., NSERC
Fox River Belt	MOU	Falconbridge Ltd.
NE Extension	Collaboration	U. of Alberta, U. of Waterloo
SW Extension	MOU	Birch Mountain, UofM.,GSC
N. Superior Province		
	NATMAP	GSC, OGS, Univs.
SE Manitoba		
Southern	NATMAP	GSC, Univs.
and	Hydrogeology	GSC, MWRB
Central Manitoba	Lk Winnipeg	GSC, AGC, Mb Hydro
	Red River	GSC, IJC, RRFPP

GSC-Geological Survey of Canada; SEM-Saskatchewan Energy and Mines;
NSERC-National Science Research Council; OGS-Ontario Geological Survey;
MWRB-Manitoba Water Resources Branch; U of M-University of Manitoba;
AGC-Atlantic Geoscience Centre; IJC-International Joint Commission on Boundary Waters;
RRFPP-Red River Flood Protection

✔ Foran Mining is undertaking a large-scale diamond drill evaluation of the McIlvenna Bay Zn-Cu deposit near Hanson Lake. The purpose of this work is to define probable reserves and expand the known geological resource. McIlvenna Bay is the second largest undeveloped zinc deposit in Canada.

Diamond exploration remains low with most work being directed at the evaluation of recently discovered kimberlite bodies.

Petroleum exploration and development expenditures are projected to be more than $1 billion in 1999, an increase of approximately 5% over 1998. It is estimated that at least 1100 oil wells and 950 gas wells will be drilled in 1999; this compares with 1068 oil wells and 626 gas wells drilled in 1998. Current and anticipated high natural gas prices have spurred exploration for and development of natural gas resources in western Saskatchewan. Reserves discovered in the Wymark area (south of Swift Current), approximately 75 kilometres east of the main gas-producing area in southwestern Saskatchewan came on production in June 1999. Infill drilling in the Burstall and Hatton pools has increased production in those areas.

Rising oil prices and opportunities provided by the implementation of deeper rights reversion regulations in 1998 have generated renewed activity in the oil sector. Production from deep Upper Ordovician Red River strata continues to increase with over 1 x 106 m^3 (6.3 x 106 bbls.) of oil produced to date. The Ceylon, Tyvan and Montmartre areas were the focus of development in 1999. The underlying Middle Ordovician Winnipeg Formation is a new exploration target in southeastern Saskatchewan. The Berkley *et al* Midale 8-16-6-11W2 well averaged 45 m^3 (283 bbls.) of oil per day in the first year of production. Higher prices and a low price differential between light and heavy crude will likely result in more than a three-fold increase in the number of wells drilled in the Lloydminster heavy oil area in 1999 compared to 1998.

The Weyburn CO_2 miscible flood project, valued at $1.1 billion, was launched by PanCanadian Petroleum Limited in May 1999. This innovative project is designed to recover an additional 21 x 106 m^3 (132 x 106 bbls) of oil from Mississippian carbonate reservoirs in the Weyburn field over the next 20 years or more. Injection of CO_2, pipelined from a coal gasification plant in North Dakota, is expected to begin in late 2000.

Manitoba Program Highlights 1999

In October 1999, the former Department of Energy and Mines underwent significant restructuring. Those branches responsible for delivery of mines related programming were incorporated into the newly-formed Department of Industry, Trade and Mines. This re-alignment recognizes the importance of the mining industry to the Manitoba economy and underscores a continuing commitment to supporting initiatives that ensure the long term viability of the mining industry and mining communities in Manitoba.

In 1999, geological programming in Manitoba continued to focus on stimulating socio-economic development by fostering a positive business climate for investment in mining and exploration within the province. Other Departmental initiatives focused on this objective include the introduction of more favourable taxation policies, continuation of the Mineral Exploration Assistance Program (MEAP), the Prospectors Assistance Program (MPAP), and the launch of the new Specialty Minerals Incentive Program (SMIP) aimed at promoting development in the industrial minerals sector. In addition, work continued on the development of a partnership protocol between aboriginal groups and the minerals industry, as well as active participation and industry consultation in the review of candidate sites for Manitoba's Network of Protected Areas.

Key to building Manitoba's competitive advantage is the provision of current and relevant geoscience information that supports the minerals industry and contributes to sustainable development and wise land management. To help meet this objective, funding levels for the Geological Survey (MGS) were increased in 1999 to $3.9 million.

Geoscience Program

The 1999 geoscience program reflects a balance between providing support to the traditional mining camps, stimulating new exploration and development opportunities in the frontier areas, and supporting land use and development priorities in southern Manitoba. Collaborative initiatives continue to be a key element in the delivery of Manitoba's geoscience program. The major collaborative initiatives currently underway are summarized in the accompanying table.

This year the Geological Survey held its second regional geoscience needs workshop. These workshops originated as an outcome of the Intergovernmental Geoscience Accord, in which all provinces (except Quebec) and the federal government agreed to terms of reference outlining respective responsibilities regarding geoscience programming. An outcome of this understanding was the need to establish a coordinated planning process, in which the regional geoscience needs of each jurisdiction were clearly identified. The first Manitoba workshop was held in January, 1997, but because many of our collaborative initiatives will be coming to an end within the next 2 to 3 years, it was decided to renew the process. The objective of the exercise was to initiate development of a strategic plan that identifies not only what our geoscience requirements will be over the next 5 to 7 years, but also identifies a strategy to ensure we have the skills to fulfill those requirements. An emphasis was placed on participation from industry and universities. The first phase of this exercise was completed in April and we anticipate completing a series of regional workshops in the coming spring.

Flin Flon/Snow Lake

Programming in the Flin Flon area continues to build on the new concepts and interpretations resulting from the NATMAP Shield Margin Project. Fully integrated digital maps and data sets from this project will be released 2000.

Long term objectives for the Flin Flon Belt include completion of a set of new 1:50 000 scale compilation maps. In support of this initiative a number of more detailed thematic projects are currently underway. These include:

- ✔ New 1:20 000 geological mapping in selected areas;

- ✔ A variety of more detailed studies focused on known areas of mineralization to identify new methods of assessing mineral potential. These include: 1) orientation surveys using phase-selective enzyme leach and mobile metal ion (MMI) analytical approaches to characterize vertical variability of the geochemical response to mineralization at Photo Lake; 2) evaluation of rare earth element (REE) signatures in rhyolites to define the origin and geochemistry of barren and ore-related rhyolites associated with VMS deposits;
- ✔ Continued collection of reference sample suites from all current and past-producing mineral deposits in the Flin Flon Belt.

Lynn Lake/Leaf Rapids

The Lynn Lake Belt was the focus of extensive mapping and mineral deposit studies during the 1970's and 1980's. As a result, the database for this area is one of the most comprehensive in the province. The current and long term objectives for this area are:

- ✔ To upgrade existing databases and maps to modern standards;
- ✔ Fill in gaps in the existing database, specifically with respect to structural geology and gold metallogeny; and
- ✔ Compile all data in a GIS format and develop data integration models using expert systems focused on probability of mineralization.

To this end several new projects have been initiated in the Lynn Lake region:

- ✔ All existing 1:50 000 scale maps in the region have been digitized and edge-matched to produce seamless coverage for the belt. These maps now form the basis for new trace element geochemistry and structural interpretations;
- ✔ Re-analysis of archival samples sets has been completed and results published in November, 1999. High precision trace and rare earth element data has been used to subdivide the greenstone belt according to tectonic affinity that identifies more productive juvenile arc assemblages as a focus for VMS exploration;
- ✔ A new mapping program of detailed structural analysis of the Johnson Shear Zone (JSZ) was initiated. Metallogenic studies into the nature and origin of gold mineralization is focused on providing insight into the processes involved in the development of shear-hosted gold deposits;
- ✔ A data compilation project has been initiated, which will focus on developing a comprehensive GIS database for the region. In addition, a data integration study will develop and "expert system", building a predictive model for shear-hosted gold mineralization.

Thompson Nickel Belt/ Superior Boundary Zone

Over the past year, mapping initiatives in the Superior Boundary Zone have extended beyond the Thompson Nickel Belt proper to include new mapping in the Fox River Belt and along the northwest Superior boundary in the Waskiaowaka and Stephens lakes areas.

Thompson Nickel Belt

The geology, metallogeny and tectonic evolution of the Thompson Nickel Belt (TNB) is the subject of a four year investigation being administered by the Canadian Mining Industry Research Organization (CAMIRO). The project began in 1997 and will continue to 2001. The study integrates existing data from mining companies and government records with a wide range of new datasets, using ArcInfo GIS software as a platform for interpreting the database.

In concert with the CAMIRO project, work continued on a new 1:50 000 scale compilation map series for the TNB. This past year, lithologic map manuscripts were completed for the Subphanerozoic portions of the TNB, in cooperation with Hudson Bay Exploration and Development Co. Ltd. and Falconbridge Ltd. Mapping in the Setting Lake area was also completed. Core logging will continue during the summer of 2000, with preparation of the remaining maps in this series scheduled for fall/winter of 2000.

Northwest Superior Boundary

The discovery of a segment of older crust, with elements as old as 3.7 Ga, in the Assean Lake area was the result of multidisciplinary mapping, structural, geochronologic and geo-

chemical investigations conducted since 1997. These studies are redefining the nature and location of the Superior Boundary Zone and are being undertaken, in part, to better constrain the setting of base- and precious-metal mineral occurrences and deposits in the area. Mapping in the Waskaiowaka Lake area this summer was focused on testing the hypothesis that the Owl River geophysical feature represents a significant geologic break. New data indicates that direct eastward correlation of Trans-Hudson Orogen domains in the Assean-Waskaiowaka lakes areas needs to be reassessed.

Fox River Belt

The Manitoba Geological Survey launched a new program in the Fox River Belt in cooperation with Falconbridge Ltd, who currently hold exploration rights to most of the belt. The Fox River Belt is the largest known continuous secton of the Superior Boundary Zone rifted margin sequence. The objectives of this program are: 1) to gather new field and geochemical data to aid mineral exploration activities, and 2) provide the framework for unraveling the history of sedimentation, volcanism and plutonism within this large, but relatively unkown segment of the Superior Boundary Zone. Work this summer focused on:

- ✔ Developing the lithostratigraphic framework for platinum group element copper-nickel sulphide mineralization in the marginal series of the Fox River Sill;
- ✔ Documenting volcanic stratigraphy of sections along the Fox and Stupart rivers.

Northern Superior Province

Manitoba's Northern Superior Initiative is now in the 4th year of a 5 year program. The objectives of this initiative are: 1) to identify regional exploration targets through new geochemical surveys and compilations of geophysical data derived from assessment files; and 2) to provide the geological framework for mineral exploration through regional mapping and thematic studies. This program has also been linked to the larger Western Superior NATMAP project which is focused on defining the crustal evolution and tectonic assembly of the Superior Province west of Lake Nipissing.

The regional multi-media geochemical sampling program continued this year in the southern portion of the Knee Lake greenstone belt. Geochemical and mineralogical analysis of these samples will continue to build a multi-element, multi-media database that will assist in the identification of potential exploration targets.

The geophysical compilation project continued this year with release of a second report summarizing geophysical data for the northern Gods Lake area. Work will continue this year on the Fox River Belt.

Other work this summer included regional, 1:20 000-scale, bedrock mapping projects in the Gods Lake and Max Lake areas. In the Max Lake area, a 1:20 000-scale mapping program was initiated in order to investigate the stratigraphy, structure and volcanic geochemistry of supracrustal rocks. This area was identified as having significant potential during the 1996 multi-media geochemical surveys.

Thematic studies in the northern Superior Province include:

- ✔ Structural mapping in the southeastern part of the Cross Lake greenstone belt;
- ✔ Study of metallogenetic and petrogenetic features of Archean anorthosites and associated mafic and ultramafic rocks; and
- ✔ Geochemical and geochronological studies of Paleoproterozoic mafic and ultramafic dikes.

Southeastern Manitoba

Mapping activity in Southeastern Manitoba is coordinated with the Western Superior NATMAP initiative and is focused primarily on updating existing mapping. In the western Rice Lake greenstone belt geochemical and geological investigations of volcanic rocks have been conducted in the Wanipigow Lake area. Mapping in the southeast Rice Lake greenstone belt was carried out in the Garner-Gem lakes area. Results of 1999 mapping in the Garner-Gem area suggest that an early east-trending fault system is responsible for

juxtaposition of Garner Lake, Gem Lake and Bidou subgroups.

Thematic studies concerning Cu-Ni-PGE potential of mafic-ultramafic intrusions in the Bird River greenstone belt continued this year. Mineral potential studies were conducted in the Mayville intrusion and Bird River Sill. Rock types and sulphide mineralization in the Mayville intrusion are very similar to those in the lower parts of anorthositic intrusions in central Ontario that are currently the focus of significant exploration programs. In the southern Bird River Belt, field work began on a potential feeder structure to the Bird River Sill north of the Maskwa and Dumbarton nickel mines. Other parts of the Bird River Sill warrant additional investigation for reef-type PGE deposits based on favourable geology and the existence of several PGE-rich sulphide zones.

Southern and Central Manitoba

The MGS continues to promote exploration and development opportunities for specialty and non-metallic minerals, such as the potential for carbonate-hosted mineralization associated with reactivation along the Superior Boundary Zone (SBZ). Mesozoic black shales were sampled within the Porcupine Hills/Duck Mountain/Riding Mountain areas, along the trend of the SBZ. Evidence of potential hydrothermal alteration was noted at several localities overlying the SBZ.

Industrial mineral activities in 1999 covered a variety of commodities including dimension stone, bentonite, carving stone, kaolin, and garnet sand. In the spring of 1999 the Geological Survey of Canada completed a seismic survey in the Sylvan area, in an effort to delineate the geometry of kaolin deposits. Results are pending; however, initial data indicate these deposits form in distinct sink holes rather than continuous channels.

The Manitoba Stratigraphic Map Series was updated, rendered in digital format and released along with the Manitoba Stratigraphic Database on CD-ROM in the spring of 1999. An update of this database is planned for early 2000 and will contain historical tops, detailed core descriptions and several updated and new maps prepared by Petroleum Branch.

The MGS is also involved in activities in the southern part of the Province that are primarily related to land use in support of sustainable development. Mineral potential maps, for the northern half of the Winnipeg Capital Region study area, were released in March of 1999. The four maps comprising the southern half of the Winnipeg Capital Region study are now being prepared for release in 2000. In conjunction with bedrock mapping, the branch is also undertaking to update aggregate maps for the Capital Region.

The MGS is involved in several large collaborative initiatives in the southern part of the province. The Winnipeg region NATMAP project, now in the 3rd year of a 4 year program, is focused on 3-D mapping, emphasizing engineering and environmental geology and surficial mapping. Mapping of the Quaternary sediments in the study area is being extended into the subsurface using drillhole data including the Manitoba Stratigraphic Database and the water well database held by Water Resources Branch). Construction of a new digital elevation model (DEM) for the southern part of the province allows relatively accurate positioning of drill holes with respect to elevation. This outstanding DEM has drawn attention to many features not previously recognized and clearly numerous applications that will be investigated in the future.

A multi-agency study of regional hydrogeology and hydrogeochemistry of the Red River Valley/Interlake region is now in its 3rd year. The program will develop an enhanced understanding of the dynamics of groundwater systems in the Red River Valley, resulting in better protection and management of existing resources within Manitoba and across the international boundary.

The MGS is participating in multi-agency initiatives to study the history, evolution, geomorphology and stratigraphy of the Red River and its sedimentary record, in an effort to define the historical frequency of large magnitude flood events. A better understanding of the relative impact of long term climatic and geologic controls on flooding will help to iden-

tify the risk of recurrence of extremely large flood events.

Geoscience Information Services

The Geoscience Information Services section has conducted an extensive program of GIS-based map compilation at regional (1:250 000) and detailed (1:50 000) scales. Digital maps at 1:250 000 have now been produced for approximately half of the Province. Detailed compilation is focused on greenstone belts, with the Lynn Lake-Leaf Rapids region the initial target area. Publishing and data distribution is evolving to CD-ROM based "electronic reports" and print-on -demand map publishing.

The Department has been working toward developing Internet map and data distribution capabilities. Government-wide changes to computer and network systems has delayed implementation of this technology; however, work is currently underway to bring this project online. One of the first projects to be posted to the Internet will provide online access to the mining claim structure, with a direct link to the claims database. Other projects currently being developed include assessment file databases and mineral deposits.

Ontario Program Highlights 1999

INTRODUCTION

Geoscience responsibilities for Ontario are delivered by:

- ✔ Precambrian Geoscience Section (PGS- Precambrian bedrock mapping and airborne geophysics);
- ✔ Sedimentary Geoscience Section (SGS- surficial geology and geochemistry, Paleozoic mapping, and aggregate);
- ✔ Resident Geologist Program (RGP – front line customer service and mineral occurrence mapping);
- ✔ Publication Services section (PSS – map and report preparation and library function through Information Services Section);
- ✔ Data Services Section (DSS- digital information archive and distribution);
- ✔ Geoscience Laboratory (GL - geochemical analysis service);
- ✔ Mining Lands Section (approval of assessment files);
- ✔ Mines Group (industrial mineral and building stone expertise).

Those administrative units that comprise the Ontario Geological Survey (OGS) are PGS, SGS, RGP, PSS, DSS, and GL. The OGS is part of the Mines and Minerals Division, Ministry of Northern Development and Mines (MNDM).

The geoscience program is focused on the support of the minerals industry.

The 1998-99 base budget for the geoscience activities of the Mines and Minerals Division (see budget table) was approximately $10 993 200.

MNDM's internet homepage is:

http://www.gov.on.ca/MNDM

Geoscience Activities – Highlights

Economic Activity

Listed according to commodity, advanced exploration projects in Ontario include:

Gold

- ✔ Markes Property, Pele Mountain Resources
- ✔ Buffalo Gold Deposit, Madsen

Petalite

- ✔ Separation Rapids Pegmatite Project, Emerald Fields Resources
- ✔ Separation Rapids Project**, Avalon Ventures

Kyanite

- ✔ Butler Antoine*, Kyanite

Barite

- ✔ North Williams*, Extender Minerals

Diamonds

- ✔ Attawapiskat Project**, Monopros

* *Did some work last year, none this year, expect them to do some more next year*

** *Advanced Exploration Projects Within Permitting Process, only projects that have a strong likelihood of starting within the next 4-6 months.*

New or Expanded Operation

Phosphate

- ✔ Kapuskasing Phosphate, Agrium Inc.

Gold

- ✔ Hislop Gold, St. Andrew Goldfields

Geoscience Program Highlights

Precambrian Geoscience Section (PGS)

The PGS program focused on:

- ✔ Geology and metallogeny of high mineral potential areas in the Superior, Southern and Grenville provinces;
- ✔ Documentation of features and setting of provincial-scale commodities (diamond potential in kimberlite and kimberlite-like intrusions, rare-metal and petalite-bearing pegmatite mineralization, Ni-Cu-PGE mineralization;

- ✔ Provincial-scale documentation of key geologic environments (distribution of FI-FIII rhyolite, metamorphic assemblages, and a geochronology database);
- ✔ Human resource strategy, digital data standards and project management practices);
- ✔ Maintenance of 20 collaborative projects with universities, governments and private sector to complement the bedrock mapping and airborne geophysical programs.

Sedimentary Geoscience Section (SGS)

The areas within the mandate of the Sedimentary Geoscience Program are:

- ✔ Surficial geochemistry;
- ✔ Surficial mapping and sampling;
- ✔ Paleozoic mapping;
- ✔ Aggregate resource inventories.

The projects completed within these areas were complimented with a variety of partnerships with universities, federal ministries and municipal agencies. Additionally, provincial scale projects involving applied research on exploration related topics and digital data collection and handling were undertaken.

In keeping with the Division's mandate, surficial mapping and geochemical projects were primarily conducted over areas of high mineral potential, *i.e.*, greenstone belts across the province. Industrial mineral programs involving aggregate and Paleozoic rocks were undertaken in areas where the demand for such products was greatest. As such, the projects included areas closer to population centres.

Resident Geologist Program (RGP)

Throughout 1999, staff of the Resident Geologist Program continued to be extensively involved in Ontario's Living Legacy (formerly Lands for Life), the Government of Ontario's land use planning initiative for Crown land that involves the creation of/ addition to 378 new provincial parks and conservation reserves across the province. Program involvement principally involved conducting site-specific mineral resource assessments and working with colleagues in the Ministry of Natural Resources to minimize the impact that this initiative may have on the mineral exploration and mining sector. Staff also continued to provide top quality customer services to clients throughout the year by responding to approximately 17 500 office visits and 22 000 telephone inquiries, conducting 350 client property visits/field investigations and over 75 mine/quarry visits and providing/leading 50 geological field trips. We're currently in the process of developing a program Internet web site to be linked to MNDM's home page. Watch for its launch in 2000.

Information Services Section (ISS)

The Information Services Section (ISS) is responsible for marketing the geoscience, tax and infrastructure advantages of Ontario for investment attraction purposes. Marketing plans for 1999 include 10 trade shows, of which 7 are international and 3 are national events. ISS also has responsibility for maintaining the Geoscience Library services and the cartographic and hardcopy publication functions of the Mines and Minerals Division, through the Publication Services Section (PSS). Between September 1998 and August 1999, 52 maps, 26 reports, 15 digital information products and 11 digital data sets were released.

Data Services Section (DSS)

The role of the Section is to assist the information gathering, access and distribution goals of the Mines and Minerals Division by:

- ✔ Developing and maintaining digital information standards, procedures, databases and access methods; and
- ✔ Managing the provision of, and in some cases operate, digital data distribution channels.

Current efforts are targeted to implementing access to the geoscience and mining lands administration information via the Internet.

Geoscience Laboratories (GL)

1998/99 was a challenging but successful year for the Geoscience Laboratories. The year was focused on streamlining operations to increase throughput and to complete the accreditation for ISO 9002. In March 1999, the

Geoscience Laboratories received its accreditation.

Over the past year a four acid closed beaker digest was formally validated to deal with the total digestion of zircons. Initial investigation began into a sinter and microwave digestion process. The GL also launched again its reference material program.

Operation Treasure Hunt

Operation Treasure Hunt (OTH) is a $19 million dollar, two-year Ontario government investment in the geoscience infrastructure of Ontario. The goal of OTH is to stimulate exploration for mineral deposits and to attract new mineral investment to Ontario. OTH will use state-of-the-art airborne geophysical, surficial and lithogeochemical geochemical, and data management technologies, and aggregate and industrial mineral inventory techniques to identify and deliver to clients new mineral exploration and investment opportunities in Ontario.

Géologie Québec

Le ministère des Ressources naturelles (MRN) appuie le développement économique durable des régions du Québec en favorisant la connaissance, la mise en valeur et l'utilisation optimale du territoire québécois et de ses ressources énergétiques, forestières et minérales.

Dans ce contexte, GÉOLOGIE QUÉBEC est l'unité administrative du MRN responsable de l'acquisition, du traitement et de la diffusion des connaissances géoscientifiques nécessaires à l'établissement et à la promotion du potentiel minéral du Québec, informations indispensables au bon fonctionnement de l'exploration minérale au Québec.

Sur une base annuelle, son personnel réalise près d'une centaine de projets allant du levé géologique de territoires nouveaux à la production de cartes d'évaluation du potentiel minéral, en passant par diverses compilations et l'opération du SIGÉOM (Système d'information géominière du Québec). Toutes ces informations sont rendues disponibles à la clientèle de l'exploration minérale sous forme numérique ou sous format papier.

En 1998-1999, GÉOLOGIE QUÉBEC dispose d'un effectif de 171 personnes (dont 113 permanents) réparti à Charlesbourg et dans six bureaux régionaux (Montréal, Sainte-Anne-des-Monts, Sept-Îles, Rouyn-Noranda, Val-d'Or et Chibougamau).

L'adresse INTERNET de GÉOLOGIE QUÉBEC EST:

http://www.geologie-quebec.gouv.qc.ca/

Le Service à la Clientèle de l'exploration et du Marketing (SCEM)

Le SCEM regroupe l'ensemble des services au comptoir offerts dans les six (6) bureaux régionaux (Montréal, Sept-Îles, Sainte-Anne-des-Monts, Rouyn-Noranda, Chibougamau, Val-d'Or). Le SCEM offre, en collaboration avec le Secteur des Forêts, des points d'accès à l'information géoscientifique à Sherbrooke et à Hull, en plus des services offerts au bureau de Québec. Chaque bureau régional est sous la responsabilité d'un géologue résident, et fournit les services suivants :

- ✔ la communication de renseignements généraux sur la géologie, le potentiel minéral, l'industrie minière, sur les programmes d'aide financière et sur la Loi sur les mines;
- ✔ la consultation, la reproduction ou la vente de documents géoscientifiques;
- ✔ l'assistance technique aux utilisateurs du SIGÉOM;
- ✔ la vente et la mise à jour des cartes de titres miniers et le traitement partiel des dossiers relatifs aux titres miniers.

Depuis le 1er juin 1999, le SCEM dispose d'une division du marketing qui s'occupe de la promotion du potentiel minéral québécois sur les scènes locales et internationales.

Le Service de la Géoinformation (SG)

Le SG révise et prépare pour publication les nouveaux documents géoscientifiques (format papier et numérique) faisant état des résultats de travaux géologiques, géochimiques et géophysiques. Le SG compile et numérise les produits de compilation géoscientifique dans le SIGÉOM.

Les informations disponibles dans le SIGÉOM au début de septembre 1999 étaient:

- ✔ la localisation des périmètres des travaux d'exploration décrits dans 90% des rapports privés d'exploration minière (documents de la série GM), pour l'ensemble de la province. Les 10% restant étaient en production;
- ✔ les indices minéralisés de l'ancienne base de données COGITE contenant les données compilées avant novembre 1993; plus de 90% des cartes de la province contenant de telles données ont été traitées. Les autres cartes sont en pro-

duction. Par la suite, les données d'après novembre 1993 seront compilées;

- ✔ la localisation, la description et la numérisation des données de quelque 90 000 forages au diamant de la province;
- ✔ 800 cartes géologiques de terrain ou de compilation;
- ✔ les résultats d'analyses de sédiments meubles de la province;
- ✔ les produits géophysiques (champ magnétique total résiduel, gradient magnétique vertical, anomalies électromagnétiques).

De plus, la compilation des blocs erratiques était complétée dans le SIGÉOM, en vue de sa diffusion ultérieure; un nouveau module était développé pour ajouter des fiches de minéraux industriels au SIGÉOM. Depuis 1998, Géologie Québec fournit à sa clientèle un accès Internet à la base de données bibliographique EXAMINE (quelque 60 000 références du fonds documentaire sur les ressources minérales du Québec).

L'adresse internet d'examine est:

http://examine.mrn.gouv.qc.ca/dex/plsql/app.debut

Le Service Géologique de Québec (SGQ)

Le Service géologique de Québec dessert un vaste territoire qui comprend les Appalaches, les Basses-Terres du Saint-Laurent, la majeure partie du Grenville et l'ensemble du territoire du Nouveau-Québec situé au nord du 55e parallèle. Une équipe constituée d'une vingtaine de géologues (à Charlesbourg, Montréal, Sept-Îles et Sainte-Anne-des-Monts) réalise les levés et les études géologiques.

En 1999-2000, le SGQ dispose d'un budget de 3,9 M$ pour réaliser 12 nouveaux projets. Encore une fois cette année, l'accent est mis sur la cartographie géologique. Ainsi, la plus grande partie des ressources sera consacrée à la réalisation de 6 projets qui généreront 7 nouvelles cartes géologiques: 1 feuille au 1:20 000, 2 feuilles au 1:50 000 et 4 feuilles au 1:250 000.

Au niveau des faits saillants, mentionnons la poursuite, dans le cadre du Programme d'exploration minière du Grand-Nord, de la cartographie géologique du territoire situé au nord du 55ième parallèle (3 feuilles 1: 250 000). Ailleurs, les principaux travaux ont été réalisés dans la Province de Grenville i.e. sur la Côte-Nord, dans la région de Mont-Laurier et dans celle du Lac Saint-Jean.

Le Service Géologique du Nord-Ouest (SGNO)

Le Service géologique du Nord-Ouest dessert l'Abitibi, le secteur de la Baie James et conjointement avec le SGQ, le Grand-Nord québécois. Son effectif est réparti dans trois bureaux régionaux situés à Rouyn-Noranda, Val-d'Or et Chibougamau. En 1999-2000, le SGNO dispose d'un budget de 3,9 M$ pour réaliser 5 projets de cartographie d'envergure et 9 études thématiques ainsi que des travaux de compilation géologique et gitologique.

Deux projets de cartographie dans le Grand-Nord génèrent de nouvelles cartes géologiques au 1:250 000 et le programme d'exploration du Moyen-Nord a permis de revoir la géologie de huit feuillets au 1:50 000. Un autre projet d'inventaire de trois feuillets au 1:20 000 dans la sous-province d'Abitibi complète la cartographie géologique. Les études thématiques en cours impliquent des travaux de métallogénie, de géochimie, de volcanologie et de géologie structurale, en collaboration avec plusieurs partenaires universitaires et industriels. Les datations géochronologiques se poursuivent, en Abitibi, et dans les terrains du Nord.

En ce qui concerne l'évaluation du potentiel minéral, les travaux actuels visent à étendre les capacités du module SPCPM dans le SIGÉOM qui produira cette année deux cartes thématiques au 1:250 000

Le Service des Minéraux Industriels et de l'Assistance à l'Exploration (SMIAE)

Le SMIAE regroupe le personnel oeuvrant dans les champs d'activité suivants: les minéraux industriels, la géochimie, la géophysique et les programmes d'assistance financière à l'exploration minière.

Le groupe des minéraux industriels réalise des études dans les domaines de la pierre de taille, des minéraux non-métalliques, des granulats et le la tourbe. Les responsables de la géochimie et de la géophysique de la compilation et traitent des données en appui aux travaux d'inventaire géologique effectués par les deux services géologiques.

Le groupe des programmes d'assistance financière a pour mandat de concevoir et d'administrer les programmes d'assistance financière à la prospection et à l'exploration minière:

- ✔ Le Programme d'assistance à l'exploration minière qui dispose de crédits de 9 M$ sur trois ans (depuis 1997) pour les prospecteurs, pour les compagnies et les Fonds régionaux d'exploration.
- ✔ Le Programme d'exploration minière du Moyen-Nord pour les compagnies.
- ✔ Les Fonds d'exploration autochtones qui disposent de 3M$ sur trois ans (depuis 1997).
- ✔ Le Programme des forages profonds dans la sous-province de l'Abitibi met à la disposition des sociétés d'exploration un budget de 5,5 M$ sur trois ans (début le 17-09-98).

New Brunswick Program Highlights 1999

Geological Surveys Branch

The Geological Surveys Branch (GSB) delivers geoscience programs through the Bathurst and Sussex regional offices and the Head Office in Fredericton. The Branch consists of three sections, Geological Surveys North, Geological Surveys South and Mineral Information Services, and has a staff of 35 with a total budget of $2 723 600 including both internal (A-base) and external funding.

Because the Branch's mandate had not been thoroughly reviewed since 1980, a comprehensive program review was carried out in 1999 by eight working groups consisting of staff mainly from the Geological Surveys Branch. Most of the recommendations in the formal report submitted to management were accepted.

In 1999, the Province continued to support the Mineral Exploration Stimulation Program (MESP), a popular incentive program that provided a total of $40 000 in assistance to 33 prospectors.

The New Brunswick Exploration Assistance Program (NBEAP), initiated in 1994, provides assistance of 50% of project costs to a miximum of $40 000 per company. For 1999-2000, $350 000 was awarded to ten junior mining companies.

The Minerals and Energy Division held its 24th annual Review of Activities in 1999. The program included a field trip, technical and poster sessions, an economic focus session entitled "New Brunswick Mineral Industry. . .Focusing on the Future," a core shack and industry trade show.

Geological Surveys North

EXTECH II: Most follow-up geological mapping was completed in the summer of 1998. A number of papers are being prepared for publication in the Economic Geology Monograph series and the Division's Current Research series.

The Geological Survey of Canada contracted the services of D.M. Fraser Inc. and Three-D GeoConsultants Limited to carry out an impact assessment of EXTECH II. They reported that EXTECH II was very effective, mainly due to the cooperative working relationship between participants in both levels of government.

Restigouche Project: In 1997 a multi-parameter airborne geophysical and multi-element geochemical survey (Phase I) was conducted in the New Brunswick in order to stimulate exploration in the area. The budget was $540 000. Results were published in 1998. Phase II (evaluation and follow-up geological mapping) was concluded in late 1998. Phase III is being carried out with a budget of $500 000. A NATMAP project is also approved for this area.

Mapping Projects: In 1999, three bedrock mapping projects were carried out in the Kedgwick, Atholville and Charlo areas of northern New Brunswick. Surficial geology mapping was carried out in the Charlo, Kedgwick and Menneval areas. A follow-up study of nickel-cobalt anomalies in the Restigouche area was also conducted. The geomorphologist carried out coastal zone mapping with emphasis on dune and beach restoration projects.

As part of EXTECH II, metallic mineral deposit studies were completed for Brunswick No. 12, Heath Steele, Restigouche, Murray Brook, Orvan Brook and Flat Landing Brook. In addition, the data on 20 major deposits was compiled as part of the Geophysical Atlas Project.

Field work was carried out at Nash Creek and an orientation survey was carried out for the Regstigouche Project.

Geological Surveys South

Mapping Projects: Bedrock mapping projects were carried out in the Hampstead, Saint John, and Fosterville areas, and along the

northeastern margin of the Carboniferous Platform. Surficial geology was mapped in the Woodstock and Millville areas. Stream and till samples were collected to investigate copper and gold anamolies in the Carboniferous Basin.

Gypsum, anhydrite, silica, glauberite and aggregate deposit studies continued in 1999. Compilation of data on the magnesium potential of the Millstream deposit is planned. The clay inventory, with emphasis on kaolin, is in progress.

Mineral Information Services

Mineral and energy rights data continue to be maintained using the CARIS-based Geographic Information System. Current and recent geoscience data (bedrock, surficial, mineral deposits, geophysics and geochemistry) are being maintained in digital format.

The Mineral Occurrence Database is continuously updated by field and literature checking. The List of Available Properties, Mineral Industry and Current Research reports continue to be published annually.

The Division's extensive collection of drill core is well maintained at Bathurst, Sussex and Fredericton drill core facilities.

The Division participated in the Cordilleran Exploration Roundup and Prospectors and Developers Association Convention in 1999. The Internet Website has been upgraded and expanded.

Mineral Industry

The preliminary value of New Brunswick's mineral production for 1998 is $852,217,726 a decrease of 10.5% from the final 1997 figure.

Mining continued at Brunswick No. 12, Heath Steele, N.B. Coal Limited and Potash Corporation of Saskatchewan mines. Several limestone and aggregate quarries and peat operations are in full production. The Heath Steele mine will close by the end of October 1999 due to the reserve depletion. The Caribou and Restigouche mines are expected to open, depending upon the metal prices.

The preliminary estimate of exploration expenditures in New Brunswick is $8.6 million, a decrease of 29.5 from 1997

Base metals, gold, gypsum, anhydrite, limestone, aggregate, oil shale, and oil and gas are the focus of exploration in New Brunswick.

Mining Industry Study

The province's mining industry has experienced some disconcerting downward trends in mineral production, employment, and exploration expenditures; as well, government revenue and budgets have decreased in recent years. To address these concerns, the Province has appointed a steering committee and contracted Dr. George Miller of IGRG Inc. to propose a strategy for revitalizing New Brunswick's mineral industry.

Nova Scotia Program Highlights 1999

Introduction

The Mineral and Energy Resources Division is the geoscientific arm of the Mineral and Energy Branch of the Department of Natural Resources. It is responsible for providing a comprehensive, integrated geoscience knowledge base for the province in support of mineral exploration and development, integrated resource management, sustainable economic development in non-mineral sectors, environmental protection, land-use planning, and scientific research. The division's program is delivered through three sections: Geological Mapping and Geochemistry, Mineral Deposit Assessment and Geoscience Information. In 1999, this program comprised 16 major projects, which operated under a budget of approximately $2.5 million.

Exploration and Development Highlights

The estimated value of Nova Scotia's mineral production in 1998, excluding petroleum, was $347 million, a decrease of 15% from the 1997 total value of $407 million. This decrease was largely due to lower outputs of coal, salt and construction aggregates. Gypsum shipments exceeded 7 million tonnes for the second consecutive year, and cement shipments increased approximately 11% over the total in1998. Employment in Nova Scotia's mining industry in 1998 totaled approximately 3700 people.

Exploration expenditures in Nova Scotia in 1999 are forecast to be approximately $5.5 million, a slight decrease from the $5.7 million in expenditures in 1998. Much of the exploration in 1999 has focused on industrial mineral commodities, including salt and potash, gypsum and anhydrite, kaolin, silica sand, barite and fluorite, aggregate, limestone and marble, and dimension stone. Of particular note, staking activity for salt and potash has increased in 1999, driven by interest in potential underground gas storage requirements arising from the Sable Offshore Energy Project. Low commodity prices resulted in relatively low levels of exploration for base and precious metals, but interest in securing new resources of lead and Zinc has attracted attention to known environments in Nova Scotia.

Properties for which companies have announced production decisions in 1999 include Georgia Pacific Corporation's gypsum mine at Melford in Cape Breton Island, C2C Corporation's zeolite property at Stronach Mountain in the Annapolis Valley, surface coal mines at Coalburn (Thorburn Mining Limited) and Little Pond (Brogan Mining), and Lynx Minerals Inc.'s barite deposit at Lake Ainslie.

Geoscience Program

Geological Mapping and Geochemistry Section

Four major projects with significant new field work operated in 1999. The Southwest Nova project completed its second year of bedrock mapping in the Meguma Group in Digby and Annapolis counties (NTS 21A/05, 12 and 21B/08, 09). When complete, this project will provide the first 1:50 000 scale bedrock maps of the area, replacing reconnaissance scale maps dating from 1967. Bedrock mapping was also carried out in the Advocate-Debert (NTS 11E/05 - 21H/08) and Sydney basins, as part of an ongoing program of studies of the Carboniferous basins in Nova Scotia. In addition to these major bedrock mapping projects, fill-in mapping was done in the Guysborough area (NTS 11E/08, 11F/05-12) to resolve problems identified in previous mapping related to stratigraphy, distribution and contact relations among units of the Guysborough and Horton groups.

In a unique opportunity, Division staff took advantage of the emplacement of the pipeline to transmit natural gas from Sable Island through Nova Scotia and New Brunswick to New England to view, sample and document a complete cross-section of the province's Quaternary geology. The "great ditch of Nova Scotia" was a temporary trench up to 3 metres deep, that extended through surficial deposits

from the Atlantic shore to the New Brunswick border. The trench provided exposures of both surficial and bedrock geology in many places where information was previously unavailable, and has thereby contributed substantially to the provincial geoscience database. Samples collected during the work will be analysed for geochemical and geotechnical properties, providing information for environmental and geotechnical studies and mineral resource assessment.

In addition to these field-based projects, work continued toward publication of maps and reports from ongoing projects. One notable highlight of this work is completion of a new, digital, 1:500 000-scale, bedrock geology map of Nova Scotia, which will be released in early 2000.

Mineral Deposit Assessment Section

Field work in the Mineral Inventory program during 1999 included field investigations of occurrences along the Eastern Shore, the North Mountain basalt and the Digby area, and in Victoria and Inverness counties on Cape Breton Island. Work also continued on populating the inventory's database, and on migrating the database to the Public Access GIS system.

Activity in the Base and Precious Metals program included work on the Cape Breton Metal-logeny project, the Brazil Lake pegmatite, zeolites and mineral occurrences along the Cobequid-Chedabucto Fault Zone. Work also continued on a project to compile data and information from 1:50,000 bedrock geology maps and mineral deposit studies along the Eastern Shore. This project will produce a GIS-based database of geology and mineral deposits information in one of Nova Scotia's important gold belts.

The Aggregate Resource program examined granular and bedrock aggregate resources in the Southwest Nova - Annapolis Valley - Hants County region. The Industrial Minerals program completed field investigations, data compilations, and marketing studies to assess the potential for dimension stone in the same area. Other activities in the Industrial Minerals program included similar investigations of limestone and marble resources in central Cape Breton Island and of feldspar resources in the South Mountain Batholith area.

Work in the Coal Resources / Basin Mapping program included correlation studies in the Stellarton Basin, mapping in northeastern Antigonish County, and documentation of fossils in selected sites across the province. The latter work is being done in collaboration with local economic development groups to develop the tourism potential of these sites.

Geoscience Information Section

Staff of the Geoscience Information Section led the Branch's Outreach activities, which are designed to broaden understanding by the public and decision-makers in all levels of government of the importance and contributions of geoscience and the mining industry to society. Toward that objective, in 1999 the Branch participated in a variety of events, lectures and other presentations, including Mining Week, the EdGeo Workshop, interpretative walks in provincial parks , talks to service clubs and classrooms, and preparation of articles for newsletters.

Activities related to Land-use issues included ongoing preparation of digital Mineral Resource Land Use maps, facilitation of reclamation initiatives to remediate closed and abandoned sites, and participation in the department's Integrated Resource Management initiative. The latter project will develop a mid- to long-term strategic plan for use of Crown lands in Nova Scotia, incorporating the interests of the minerals, forestry, parks and wildlife sectors in Natural Resources.

The Branch's Drill Core Library, located in Stellarton, houses an extensive collection of core acquired from exploration for base and precious metals, coal, and industrial minerals, as well as sample collections, a digital drill-hole database and a complete, microfiche set of the province's Assessment Files. Staff housed at the Library maintain these databases, collect and curate new materials and provide expert service and advice to clients on an on-going basis. As part of the latter service, Drill Core Library staff monitor exploration activity across the province, in collaboration with the province's three Regional Geologists.

The Digital Information Services group continued in 1999 to make progress toward the Branch's goal of providing Internet access to all of its information and data. At present, available digitial data can be accessed through the Public Access GIS system, which is available to the public through a terminal in the Department's library in Halifax, or downloaded from the Branch's Internet site (http://www.gov.ns.ca/natr/meb). Downloads are free. In 1999, important improvements were made to the querying and display capabilities of the Public Access GIS, and additional information was digitized and added to the system. A major step toward placing the system on the Internet was made in 1999 with the acquisition by the Department of internet map server software compatible with the Arc-Info based GIS system. Staff of the Geoscience Information Section will work closely with the Division's geoscientists and other Branches in Natural Resources to transfer the current system to the Internet as quickly as resources permit.

Prospectors Assistance Program

Nova Scotia's Prospectors Assistance Program is delivering its third year of support in 1999-2000. The program is funded by the Canada - Nova Scotia Economic Diversification Agreement, and has a value of $600 000 over 4 years. It comprises three components:

- ✔ Introductory and advanced training courses for prospectors;
- ✔ Grants of up to $5000 to assist property work; and
- ✔ Marketing assistance to allow prospectors to attend trade shows. Prospectors are required to contribute an amount equal to at least 30% of the government contribution.

In 1998-1999, the Program provided assistance grants totaling $83 140 to 22 prospectors, and funded travel by 17 prospectors to market properties. Trips were supported to the Cordilleran Roundup in Vancouver (4 prospectors), the annual meeting of the Prospectors and Developers Association of Canada in Toronto (12 prospectors) and the Landscape Ontario trade show in Toronto (1 prospector).

Some $190 000 is available in 1999-2000 for all three components of the program. Twenty-eight prospecting assistance grants were awarded in the spring of 1999, with an estimated total value of $133 060.

Newfoundland & Labrador Program Highlights 1999

Introduction

The Geological Survey of Newfoundland and Labrador's (GSNL)'s program for 1999-2000 consisted of approximately 25 projects having a total budget of $3.3-million. An additional $200 000 was allocated to the Survey from elsewhere in the Department of Mines and Energy, on a one-time basis, for a total operating budget in 1999-2000 of $3.5-million. The budget was funded from the provincial treasury and represents the last year of the three-year funding regime established under Program Review (1997-2000).

Exploration expenditures in the province during 1999 is expected to come in at $34-million. About $16-million of that is projected for Labrador, including approximately $13-million by Voisey's Bay Nickel. This is down considerably from last year due to the cancellation of Donner Minerals Ltd.'s exploration program on its "South Voisey's Bay" Project. Approximately $18-million is projected for expenditure on the Island, a significant increase over previous years due, in part, to the increased joint-venture activities in central Newfoundland. Some 10 000 claims were staked in the province in 1999, nearly all of them on the Island. They form part of the 57,000 claims projected to be in good standing at the end of the year.

Program Highlights

Bedrock Geology Surveys

Detailed 1:50 000-scale mapping was carried out in the Nain area of Labrador by Bruce Ryan, who concentrated on subdividing the various intrusive units of the Mseoproterozoic Nain Plutonic Suite. (Bruce was also selected as the inaugural winner of the Provincial Geologists Medal.)

Mapping continued in the Grenville Province at 1:100 000-scale. Don James was joined by Leo Nadeau of the Geological Survey of Canada, and together they greatly facilitated coverage of the Paleoproterozoic Mealy Mountain Intrusive Suite in the area south of Lake Melville. Charles Gower, working farther to the east, mapped granitoid gneisses intruded by the Mesoproterozoic Upper Paradise River Intrusive Suite.

Detailed stratigraphic and biostratigraphic analysis of the Cambro-Ordovician shelf sequences in western Newfoundland were continued by Ian Knight and Doug Boyce. They worked specifically in the area of the Philip's Brook anticline, a region north of Stephenville determined to be transitional between sequences on the Port au Port Peninsula with those in the Corner Brook area.

The stratigraphy and structure of the Lower to Middle Ordovician Wild Bight Group at Badger Bay were mapped by Brian O'Brien. His 1:50 000-scale mapping also included the Red Indian Line, the contact between the Exploits and Notre Dame subzones of the Dunnage Zone. This mapping project also received input from Brian McConnell of the Geological Survey of Ireland (GSI). Dr. McConnell is part of an exchange arrangement between GSI and GSNL under the Newfoundland and Labrador - Ireland MOU. He will be contributing to the geochemistry of felsic volcanic rocks in the area.

The Siluro-Devonian Twin Lakes gabbro and its Lower Ordovician Robert's Arm Group country rocks were the focus of 1:50 000-scale mapping by Lawson Dickson. He delineated a felsic-volcanic unit that contains significant stockwork mineralization.

Geochemical Surveys

A till-sampling survey was conducted in the Seal Lake - Wilson Lake area of Labrador by John McConnell, following up regional base-metal anomalies. Traversing perpendicular to the ice-flow direction, samples were taken from the relatively unweathered C-horizon. The B-horizon was also locally sampled for media-comparison purposes.

Surficial Geology Surveys

The surficial geology of a large area in the Stephenville area of western Newfoundland was mapped at 1:50 000-scale by Martin Batterson. Based on raised beaches, the marine limit was shown to decrease from 65 m in the west to 26 m in the east, with ice-contact glaciomarine sediments well developed below the limit.

Till sampling (1100 samples collected) and ice-flow studies were conducted by Dave Taylor and Dave Liverman in the Grand Falls and north area. Ice flow occurred in an early easterly direction and a later northerly one.

A brief surficial-aggregate study was conducted by Jerry Ricketts in the Ferryland area to help locate new deposits of sand suitable for ice control. The existing deposits are in conflict with cabin developments.

Mineral Investigations

A new project was initiated by Cyril O'Driscoll to map the late Precambrian(?) Powder Horn Intrusive Suite in the Goobies area. The suite contains the Lodestar gold prospect, which was shown to be in a breccia developed along the contact between the Neoproterozoic sedimentary country rocks and an early gabbroic phase of the suite.

Epithermal gold environments of the Avalon Zone continued to be investigated by Sean O'Brien and Cyril O'Driscoll of GSNL with the collaboration of Benoit Dubé of the GSC. The Lodestar prospect, for example, is considered to be the product of a magmatic-hydrothermal system. Pre- and post-mineralization quartz - feldspar porphyries in the prospect are suggestive of porphyry gold-copper environments.

Significant improvement was made in the Mineral Occurrence Data System (MODS) in 1999. MODS contains over 5000 descriptions of individual showings, prospects, *etc.* from around the province. These data have now been re-organized by Greg Stapleton et al. into one digital-database record in MS-Access, making data capture and retrieval much simpler for staff and clients. An abbreviated version of MODS is also now accessible via the Internet.

North Atlantic Minerals Symposium

The first North Atlantic Minerals Symposium or NAMS was held in Dublin on September 19-21, 1999. Sponsored and organized by the Geological Survey of Newfoundland and Labrador and the Geological Survey of Ireland, it represents yet another cooperative effort under the auspices of the MOU between Ireland and Newfoundland and Labrador. Over 200 participants attended the meeting, which featured an eclectic minerals program dealing with everything from geoscience to commodity markets. Mineral deposit field trips in Ireland and Northern Ireland were an excellent postlude to a successful conference. The next NAMS takes place in St. John's in May 2001 as part of the GAC-MAC Annual Meeting.

Open House 1999

The 23rd Annual Review of Activities of the Mines Branch took place on November 4, 1999. This year it was held in conjunction with the joint annual meeting of the CIM Newfoundland Branch and the Association of Professional Engineers and Geoscientists of Newfoundland. Some 500 delegates attended the meeting, which appeared to be marked by a greater optimistic air than in recent years. A fine delegation of GSC scientists and Directors were also on hand, some of whom participated in planning sessions with GSNL managers as part of the Joint Geoscience Programs Committee. The "Open House" included reviews of GSNL and GSC field activities, mining and exploration activities, and student research projects at Memorial University. Technical presentations included talks on the Betts Cove Ophiolite, till geochemistry, the Grenville Province, and the economic potential of part of the Robert's Arm - Buchans belt. Twenty-eight posters were also on display during the Open House and CIM-APEGN meeting. Finally, the CIM Newfoundland Branch used the occasion of this year's meeting to present Minister Grimes with a Certificate of Appreciation for the Department of Mines and Energy's twenty plus years of support and participation in Branch activities.

Northwest Territories Program Highlights 1999

Introduction

On April 1, 1999, the Northwest Territories divided into two new territories: Nunavut and NWT. Following division, the mandate of the GNWT's Department of Resources, Wildlife and Economic Development (RWED) for geoscience training and research in Nunavut ended, and their focus shifted to the new (western) Northwest Territories. In contrast, the Department of Indian Affairs and Northern Development's (DIAND) mandate for resource management is still a pan-northern responsibility, and during a transition period while DIAND establishes a Regional Office in Nunavut, the Yellowknife Office is continuing to administer mining regulations and track exploration activity in Nunavut.

In March 1999, DIAND, RWED and the Geological Survey of Canada (GSC) signed a five-year Trilateral Memorandum of Understanding for geoscience program delivery in the NWT. The agreement outlines a framework for continued collaboration and cooperation in areas of common interest, and improved communication between the three agencies.

DIAND NWT Geology Division

The NWT Geology Division tracked exploration and mining activity, monitoring progress and analytical results from exploration programs across the NWT. District Geologists visited 16 exploration properties, and initiated two studies: a compilation of metallic mineral showings in the southern Bear Province, and research on the mineralogy and geochemistry of non-kimberlitic alkaline rocks in the Slave Province. The latter study will have implications for the interpretation of regional till sampling results.

DIAND's mineral showings database, NORMIN.DB, underwent some changes in 1999. A new data entry application was created which increases the efficiency of data entry, and a new web application, scheduled to go on-line late in the year, provides a more user-friendly interface and allows clients to download data directly from the Region's web site. A second database, the Kimberlite Indicator and Diamond Database (KIDD), was initiated. KIDD contains data on picking results from till samples, compiled from publicly-available assessment reports filed by diamond exploration companies. KIDD data are contained in ArcView, and can be integrated with the Division's kimberlite database, which contains information on pipe size, facies, age, diamond grade, and other data.

A new initiative, the Canadian Geoscience Knowledge Network, conceived by the National Geological Surveys Committee late in 1998, presents an opportunity for DIAND to web-enable its Open File bedrock geology maps. The Division has dedicated resources for this, and plans to participate in the pilot project to be proposed late in 1999.

RWED Minerals Oil and Gas Division

RWED Minerals, Oil and Gas Division (MOG) carried out three prospector training courses in 1999, and grubstakes worth $75K were distributed to eighteen prospectors. In addition, a prospecting and geology camp for youth from across the NWT was held. The course included an excursion to Sudbury, Ontario, where they were taken on various geology-related tours, as well as the campuses of Laurentian Univeristy and Cambrian College. Other training activities included a paleontology program in Norman Wells, and a gem and mineral exhibit at the Prince of Wales Heritage Centre.

MOG continued to develop Web sites and Internet GIS applications that assist in resource development. In April, they developed the on-line Fort Liard Resources Directory, which contains spatial and textual information on the physical environment, resource interests, and land use in the region. Their most recent project, the Beaufort - Mackenzie Mineral Development Area (BMMDA) Web Site, was created in partnership with the Joint Secretariat and Inuvialuit Regional Corporation. The site is a comprehensive guide to the geology,

hydrocarbon and mineral resources, environmental data, economic studies, and development processes in the Inuvialuit Settlement Region. Both sites have interactive GIS capabilities, and allow on-line queries.

Joint Initiatives

RWED and DIAND continue to run a shared geoscience office (the C.S. Lord Northern Geoscience Centre), from which they jointly deliver their geoscience programs. Two projects were delivered in 1999. C.S. Lord staff collaborated with the GSC to initiate the Yellowknife EXTECH project, designed to improve understanding of the geological setting and controls on mineralization in the Yellowknife gold mining camp. The bedrock mapping component, a mineral showings study, project coordination and data management are being carried out by staff at the C.S. Lord Geoscience Centre. In addition, a bedrock mapping project in the southwestern Slave Province (Snare River area) continued in 1999. The project is providing field support for a Ph.D. study on the area's thermochronology, as well as three B.Sc. theses.

The NWT Protected Areas Strategy (PAS) received ministerial approval from RWED in the spring of 1999, and from DIAND the following fall. Under the PAS, an assessment of an area's resource potential (including minerals, oil and gas) is triggered in response to identification of a candidate protected area. RWED Minerals, Oil and Gas Division and DIAND Geology Division are currently working on developing a resource appraisal methodology. DIAND organized a workshop in September, to evaluate different resource appraisal techniques used elsewhere. The workshop was jointly funded by DIAND and RWED, and participants included representatives from industry, communities, and government geological surveys. The target date for completion of a resource appraisal methodology for the NWT is February 2000, when a NWT-wide PAS workshop is scheduled.

Exploration/Mining Activity

Metal mining in the NWT took a downturn in 1999. In the early part of the year, Miramar's Con Mine continued on care and maintenance as a result of a labour dispute. The dispute was settled in May, and the mine resumed gold production in June.

Royal Oak Mines, the owner of Giant gold mine in Yellowknife, went into receivership in June 1999. The receiver, Pricewaterhouse-Cooper continued to operate the mine until October, when the operation was shut down and employees were laid off. Miramar is currently in the process of negotiating with the receiver, DIAND, GNWT, and the City of Yellowknife to purchase the Giant Mine.

Ekati Diamond Mine continued to produce diamonds from the Panda Pit in 1999. Between February and the end of July, 1999, a total of 936,300 carats of rough diamonds were sold for $153.48 million US, averaging $163 US/carat. Diavik, owner of a second proposed diamond mine, underwent environmental assessment. In June, the Canadian Environmental Assessment Agency filed a Comprehensive Study Report, and in early November the project received approval to proceed from the Minister of the Environment.

Mineral exploration in the NWT was dominated by diamond exploration. Bulk samples from two properties were collected to evaluate diamond grade and quality. Monopros Ltd. (along with partners Mountain Province Mining and Camphor Ventures) bulk sampled four pipes at Kennady Lake: results announced to date are for the Hearne pipe, which yielded 1.8 ct/t from a 469 tonne sample, and the 5034 pipe yielded 1.71 ct/t from a 573 tonne sample. Winspear Resources and Aber Resources reported bulk sample results from two pits on the Snap Lake property: Pit #3 yielded 1.732 ct/t from 2982 tonnes, and Pit #4 yielded 1.845 ct/t from a 3004 tonne sample. In addition to advanced exploration, till sampling, geophysics and delineation drilling were carried out on several properites.

Exploration for base metals was carried out on the Sunrise property (Aber Resources and Hemisphere Developments), at Russell Lake (Tyhee Development and Fortune Minerals) and near Paulatuk (Darnley Bay Resources). In addition, drilling was carried out by Fortune Minerals near their NICO Co-Au-Bi-Cu deposit, and Canadian Zinc Corporation explored

for Pb-Zn near its Prairie Creek property in the northeastern Cordillera (southwestern NWT).

In contrast to the trend for mineral exploration, oil and gas exploration saw a resurgence in 1999. Chevron, Ranger Oil, Amoco, and Purcell Energy were actively exploring for natural gas in the Fort Liard area in southwestern NWT. In the Beaufort Sea/Mackenzie Delta area, rights to four new parcels were issued in September (winning exploration bids ranged from $35 to $53 million).

Geoscience Forum 1999

The 1999 Yellowknife Geoscience Forum, to be held in November, will include technical talks, workshops and displays on mineral, oil and gas exploration activity, government geoscience initiatives, environmental issues, and the NWT regulatory regime. Following this year's forum, the GSC and Yellowknife CIM are organizing a short course on the geochemical and geophysical properties of the upper mantle.

Yukon Program Highlights 1999

Overview

Now in its fourth year, the Yukon Geology Program is a de facto Yukon Geological Survey consisting of two integrated and jointly managed offices with different administrative structures. Federal funding is provided through the Exploration and Geological Services Division of the Department of Indian Affairs and Northern Development (DIAND), while Territorial and cost-shared (YTG/DIAND) funding comes through the Mineral Resources Branch of the Department of Economic Development (YTG). The Geological Survey of Canada (GSC) also maintains an office with the Program.

The Yukon Geology Program is an informal and temporary organization that will be transformed into a Yukon Geological Survey when the responsibilities of the Northern Affairs Program are devolved to YTG. Negotiations have met delays, and the target date for devolution has been moved ahead one year to April 1, 2001. The agreement in principal for the transfer is near completion and all parties expect negotiations to be successful.

During the past year, the Program benefited greatly from staff stability after the turnover of five management positions and five technical positions in the previous two years. Staff changes this year included the appointment by the Government of Yukon, of a third Resource Assessment Geologist and a term MINFILE geologist. YTG is also in the process of hiring two GIS technicians.

A milestone for the program this year was the completion of the second Yukon Geoscience Planning Workshop in March, when 42 representatives from industry, academia, and government met for two days in Whitehorse to reexamine the state of Yukon Geoscience. The group produced a new set of priorities that will be an essential planning tool for the Yukon Geology Program over the next few years.

Program Highlights

Fieldwork

The Yukon Geology Program has committed substantial resources to the Ancient Pacific Margin NATMAP (National Mapping Program) project. The Yukon Geology Program contribution includes ongoing work in the Finlayson Lake Massive Sulphide District, fieldwork begun last year in the Glenlyon area, mapping by the GSC of the western half of Wolf Lake map area and the northern half of Jennings River map area in B.C. in partnership with the B.C. Geological Survey Branch., and surficial studies by in the Stewart River map area in conjunction with regional surficial studies by the GSC.

Another major effort by the YGP is to synthesize and enhance the geological database of the Anvil District. The Faro Mine remains closed for the forseeable future, but the possibility remains for renewed exploration and mining at some point. The project will be complete in 2000 with release of 1:25 000 scale bedrock compilation maps, surficial maps and a till geochemical survey and a lithogeochemical study of the Grizzly Deposit.

In 1998, responsibility for oil and gas resources was transferred to YTG from the federal government, and in 1999 the Yukon's first land sale in more than 20 years was successfully completed. In order to accommodate increasing interest from YTG and industry in hydrocarbon-related geoscience, a mapping project was begun to evaluate coal, oil and gas potential near Division Mountain along the western margin of Whitehorse Trough.

Studies of Yukon gold occurences focussed on those related to the Tombstone intrusive suite northeast of the Tintina Fault, and those in the Dawson Range along trend from the Pogo Deposit in Alaska. Students from James Cook University - Australia, University of Western Australia, University of Colorado and University of British Columbia received sup-

port from the YGP to study various aspects of Yukon gold occurrences.

Studies of the relationship between sedimentology, grain size distribution, and water quality of effluent from placer deposits were in their second year. The results will assist with the technical review of the Yukon Placer Authorization in 2001.

Other Projects

The YGP supported the work of several scientists at the Geological Survey of Canada. The Yukon Digital Geology Compilation was finally completed at the end of the year and is now available. It includes compiled data sets of bedrock geology and glacial limits (new syntheses, geochronology, paleontology, mineral occurrences (Yukon MINFILE), a compendium of coloured aeromagnetic images, Yukon Park boundaries, and physiography. The glacial limits map for the Yukon was released separately.

A study of Yukon VMS deposits is nearing completion and a synthesis of Yukon metallogeny has been initiated.

The YGP is now benefiting from the services of a half time publications manager, who also represents DIAND on the Mining and Environmental Research Group (MERG), and manages the Yukon Geoprocess File (see below). MERG is a cooperative working group promoting research into mining-related environmental issues. It is made up of the Federal and Yukon Governments, mining companies, Yukon First Nations and non-governmental organizations.

Mineral Resource Assessments

The Yukon Geology Program is responding to an increasing need for geological and metallogenic information to assist resolution of land use issues and conflicts. Some of the pressures have come from native land claims negotiations, and localized land use conflicts such as one within the city limits of Whitehorse, but most important is the priority of the Yukon Government to implement the Yukon Protected Areas Strategy. The goal of the Yukon Protected Area Strategy is protection and withdrawal of land from industrial activity in all 23 ecoregions in the Yukon. YTG Economic Development intends to provide efficient and cost-effective input into the selection process by undertaking a Yukon-wide mineral potential study. Providing information on mineral potential at a regional scale will assist in guiding the selection of candidate protected areas toward areas of lower potential, to minimize impact on the access to mineral wealth.

Industry Liaison and Support

Two staff geologists continued to monitor Yukon hard rock and placer mining, and mineral exploration activity, visit active properties, review reports for assessment credit, and maintain the assessment report library.

Yukon Minfile

Yukon MINFILE is another mainstay of the Yukon Geology Program. An upgrade from Microsoft Access Version 2 to Access 97 has been completed with major revision and simplification of the database structure. An update will be released on CD-ROM this spring.

Yukon Geoprocess File

The Yukon Geoprocess File is an inventory of information on geological process and terrain hazards, including 1:250 000 scale maps showing permafrost, landslides, recent volcanic rocks, structural geology, and seismic events and also includes references and summaries of bedrock and surficial geology. The Geoprocess File is intended as a planning aid for development activities and is available for most areas south of 66E latitude. The maps will be available in colour, on a single CD.

H. S. Bostock Core Library

The H.S. Bostock Core library contains about 128 000 m of diamond drill core from about 200 Yukon mineral occurrences. Confidentiality of material is determined on the same basis as mineral assessment reports. Confidential core can be viewed with a letter of release from the owner. Rocks saws and other rock preparation equipment are available to the public.

Nunavut Program Highlights 1999

The Territory of Nunavut was created on April 1st 1999. The Territory comprises about 2 million square kilometres in the eastern half of the Canadian Arctic. It includes a population of 28 000 in 27 communities.

Prior to the creation of Nunavut, geoscience was primarily conducted by the federal government through the Department of Indian and Northern Affairs (DIAND), and by Natural Resources Canada through national programs of the GSC.

The administration and regulation of lands and resources in Nunavut is still managed by DIAND through its Yellowknife office, however, plans are underway to transfer that function to Iqaluit, the capital of Nunavut, during 2000. The federal government has committed to transferring Provincial jurisdictional responsibilities to Nunavut, but a timetable has not yet been established.

In September, 1999, the Canada-Nunavut Geoscience Office (CNGO) was established as a partnership between the Government of Nunavut, DIAND and NRCan. Its mandate is to establish geoscience capacity in the Territory and to collect and distribute geoscience information in support of sustainable development. CNGO offices are located in Iqaluit with a Chief Geologist, four staff geologists, and office and GIS support.

CNGO is currently planning ten geoscience research projects which vary in duration from two to four years. These projects were established as a result of a geoscience assessment and needs workshop, conducted by the founding partners. All these projects are planned to be complete some time in 2003. Briefly, these include:

- ✔ In the Northeastern Mainland, an integrated mapping program of Archean granite gneiss in the Prince Albert Group greenstone belts;
- ✔ In the Central Baffin Island area, mapping of part of the Trans-Hudson Orogen;
- ✔ In the Arctic Islands area, a Paleozoic zinc-potential study;
- ✔ In the Western Churchill, completion of several ongoing NATMAP investigations;
- ✔ Thematic studies of localities of known economic importance (Meadowbank, Nanasivik, diamonds, Slave Province);
- ✔ A digital compilation project covering all of Nunavut;
- ✔ An enhancement program of existing datasets to raise awareness of the geological potential of Nunavut;
- ✔ A Geoscape Project focussed on displaying geoscience information in a meaningful manner to the layperson;
- ✔ A GIS Trainee Program in Iqaluit that will be offered to high-school and college students;
- ✔ A Climate Change Project to raise awareness and study the impact in Nunavut.

Discovery Methods for Canadian Metal Mines that Opened in 1999

New Mines in SASKATCHEWAN - 1999

Mine	McClean Lake	Konuto
Ownership	Cogema Resources Inc (70%) Deninson (22.5%) and OURD Canada (7.5%)	Hudson Bay Mining and Smelting Co., Ltd.
Discovery (New - N or Old - O)	N	N
Date of Original Discovery	1979-1990 (multiple orebodies)	1994
NTS	64L-05	63L-09
Location		1 km east of Denare Beach
Years of Operation	1999 -	1999 -
Methods of discovery	geological modeling, geophysics	geophysics, drilling
Methods of later developments	drilling, geological modeling	drilling, evaluation decline
Discovered reserves	North and South 229 300 t at 2.43% U3O8 Jeb - 71 700 t at 3.29% U3O8 Sue A - 55 000 t at 1.49% U3O8 Sue B - 90 000 t at 0.86 % U3O8 Sue C - 249 900 t at 5.3% U3O8	1 600 000 t at 4.0% Cu, 1.2% Zn
Mining Type	open pits (only Jeb and Sue C mined)	underground
Commodities	U	Cu, Zn, Au
Deposit classification	unconformity associated uranium	VMS
Capital Cost	$250 million	$28 million
Workforce	328	64

MINES OUVERTES AU QUÉBEC EN 1998-1999

Mine	**East Amphi**	**Bell Allard**
Découverte nouvelle (n) ou ancienne (a)	a	n
Date d'ouverture officielle	**03/99**	**07/99**
Date découverte originale	1923	•
Méthode de découverte	**prospection**	**forage**
NTS	32D/01	32F/13
Localisation	35 km à l'ouest de Val-d'Or	Matagami
Années d'opération	fermée depuis la fin de l'été 99	1999 (6 mois)
Réserves actuelles	réserves probables: 1,1 Mt à 5,07 g/t Au	3,2 Mt @ 13,77% Zn 1,5 % Cu, 43,45 g/t Ag, 0,76 g/t Au
Production en 1998	NIL	NIL
Emploi	0	250
Type d'exploitation	Ciel ouvert	Souterraine
Substances extraites	Au	Zn, Cu, Ag, Au
Classification du dépôt	•	•

Survey of Hard Rock Drill Core Programs 1998-1999

SURVEY OF HARD ROCK DRILL CORE PROGRAM IN CANADA
Fiscal Year 1998-99

PROVINCE	B.C.**	ALBERTA	SASK.	MAN.	ONT.	QUEBEC	N.B.	N.S.	NFLD. & LAB.	P.E.I.***	YUKON	NWT****
No. of Facilities	0	1	1	4	5	3	3	3	6	1	1	1
Staff Person Days Worked 1998-99	0	100	126	0	200	0	1 170	610	700	0	145	0
Capital Cost 1998-99 ($ x 000)	NIL	6.0	0	5.3	NIL	17	40.0	0.0	0	0.5	10.0	0
Operating Cost 1998-99	0.0	24.0	19.9	2.7	22.6	NIL	20.0	15.0	27.7	0	20	7.0
Core Collected and/or Delivery 1998-99	0	3 600	2172.25	5 232	27 079	0	20 500	12 699	7 790	2 500	400	0
Core Reduction*	NIL	4 000 m	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Use of Facilities Person Days (pd) 1999-99 Visits (v)	0	50	42	16 V	263 v	6	200 pd	381	204 md	0	100 v	8 v
Total Core in Storage (from all years in metres)	0	37 200	82 624	225 232	1 166 327	137 624	608 600	658 049	947 207	3 670	124 800	32 638
Total Exploration Drilling 1998-99 (in metres)	170 000	30 000	187 780	106 684	450 600	NIL	30 000	12 000	95 000	0	19 360	151 000

* *Over last year*

** *There are no facilities for hard rock core in B.C.*

*** *There is no hard rock drill core in storage.*

**** *includes Nunavut*

APPENDIX

FUNDING GOVERNMENT GEOLOGICAL SURVEYS: HOW MUCH IS ENOUGH?

A Report to Mines Ministers

by

A Task Force Appointed by
The Intergovernmental Working Group on the Mineral Industry

56th Annual Mines Ministers Conference
Charlottetown, Prince Edward Island
September 1999

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CONCLUSIONS

The industry members of the Task Force have concluded that:

1. There is a direct relationship between government geoscience, mineral exploration investment and the discovery and production from new mineral deposits. Other countries with untapped mineral wealth also recognize this relationship and are becoming more competitive for exploration dollars with each passing year.

2. It is clear that the continued erosion of funding for government geoscience has contributed to Canada losing its competitive edge as a place to invest in mineral exploration.

3. There has been a significant change in the structure of mineral exploration industry in the past decade. Junior companies are increasingly doing the majority of early stage grassroots exploration, adding value to the properties and marketing the advanced properties to major mining companies. These junior companies cannot fund large regional studies and will therefore invest their exploration dollars in areas with good geoscience databases either here or abroad.

4. There are large areas of this country that have never been mapped in sufficient detail. There are many areas where geophysical data is outdated and needs to be redone by new high resolution methods.

5. Many of the areas for which regional and or detailed maps exist were mapped many years ago and do not incorporate either current geoscientific thinking or new understanding of the occurrence and formation of mineral deposits. For example, two decades ago we did not know that Canada was about to become a diamond producing country.

6. A review of the current status of geoscience map coverage in Canada demonstrates that there is a large gap between the current level of effort and the effort required to:

   ✓ Cover all areas of the country that have either not yet been mapped or not surveyed at a satisfactory scale; and,

   ✓ Update maps and surveys to incorporate advances in geoscientific thought.

7. The Task Force has established a target that, if achieved over the next ten years, would sustain Canada's competitive advantage. This plan should be viewed as preliminary, but it does outline in general the scope of the total investment required by both levels of government.

8. Despite the different geoscience needs of different jurisdictions in Canada, we believe that the country as a whole would benefit from a national geoscience mapping strategy. We would like to see both levels of government and industry work together to achieve this goal.

RECOMMENDATIONS

The industry members of the Task Force recommend that:

- ✓ In order to stimulate new investment in the mining sector in Canada, a collective commitment to reach the ten-year target proposed by this Task Force should be made by all provincial, territorial and federal governments; and,
- ✓ This target be achieved through a cooperative approach such as a national geoscience mapping strategy.

INTRODUCTION

Canada's geological survey organizations have played a critical role in the development of this country's mineral and energy resources for more than 150 years. Geoscience knowledge, provided by governments as a public good, is the basis upon which the private sector plans and conducts its exploration activities. The mining industry has identified this publicly accessible geoscience knowledge as one of Canada's key advantages in attracting investment in the increasingly competitive global mineral exploration market. For example, according to a recent poll of North American mining companies:

> *"Canada scored highest of the countries studied on the quality of the information on investment conditions and geoscience. In response to the question "Do you have access to up-to-date high quality government data sets on investment conditions to allow you to make strategic decisions on exploration investment?", 73% of respondents said "yes" for Canada; corresponding figures for the U.S., Chile and Mexico were 62%, 49% and 37%,. Asked to rate the quality of government geoscience information data bases as excellent, average or poor, the response for Canada was: 86%, 14% and 0%; for the U.S.: 43%, 50% and 7%; for Chile: 13%, 50% and 37%; and for Mexico: 2%, 36% and 62%."*

This positive assessment is no reason for complacency. Two factors place Canada's relative competitive advantage at risk. First, the geoscience knowledge base is eroding as a result of advances in science and technology which gradually decrease the utility of existing data, coupled with the long term decline in overall funding of geological surveys. Second, Canada's principal competitors for exploration investment are rapidly upgrading their own stores of geoscience knowledge.

A multi-stakeholder workshop entitled "Canada's Geoscience Knowledge Base: Maintaining Our Competitive Advantage" was held in conjunction with the 54th Annual Mines Ministers' Conference in St. John's, Newfoundland in July, 1997. The workshop report noted that while exploration expenditures in Canada had rebounded significantly since the recession of 1991-92, the increase was less than in many other parts of the world. In other words, Canada's "market share" of global exploration investment had decreased. The report also documented a long term decline in the funding levels of Canada's geological survey organizations which, if left unchecked, would erode the competitive advantage provided by the geoscience knowledge base.

The principal recommendation from the St. John's workshop was that IGWG strike an industry-led task force to examine funding options for federal and provincial geological surveys. This was done and the Task Force tabled its report entitled "Alternative Funding Arrangements for Government Geological Surveys" in July 1998 at the 55th Annual Mines Ministers' Conference in Calgary, Alberta. This report documented the role of government surveys in the mineral exploration process, examined a number of funding and organizational models used by geological surveys in various parts of the world, and recommended which of these were viewed to be most appropriate in the Canadian context. The Task Force also made a cursory assessment of the state of existing geoscience map coverage and estimated that satisfactory coverage at regional scales exists for only 65 to 70% of the Canadian landmass. Moreover, it drew attention to the fact that at the current level of survey activity, geoscience maps are becoming obsolete more rapidly than they are being replaced.

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1 *The current membership of the Task Force is listed in Appendix A.*

Although it concluded that the protracted decline of funding of geological surveys has contributed to Canada's decreased share of the global mineral exploration market, the Task Force did not estimate what level of spending would be required to reverse the erosion of the knowledge base. Thus, the Task Force was directed to undertake a more rigorous review of the current state of geoscience map coverage and to make recommendations with respect to the levels of expenditures that would be required to sustain the geoscience knowledge base as a competitive advantage for Canada in attracting exploration investment over the longer term.

APPROACH

Government surveys provide a wide variety of geoscience knowledge in the form of maps, reports, data and expertise. This knowledge is applied in areas as diverse as exploration for mineral and hydrocarbon resources, mitigation of the risks posed by natural hazards, and environmental assessment and land use planning. Moreover, this knowledge is generated at various levels of detail, or scales, to meet different needs. Thus, in order to determine what level of government investment would be required to sustain the competitive advantage provided by Canada's geoscience knowledge base, it is first necessary to understand what kinds of geoscience knowledge are required, at what level of detail, and what is the current state of that knowledge.

The geoscience knowledge required to attract and guide mineral exploration is primarily in the form of maps and data that can be depicted on maps. There are many different parameters that are relevant to exploration. For the purposes of this report, the Task Force has evaluated the need for four kinds of data that are considered critical: bedrock geology, surficial geology, airborne geophysics and drainage sediment geochemistry.

Mineral exploration relies on geological, geochemical and geophysical data collected at a variety of scales. As a general rule, progressively larger scale (i.e., more detailed) maps and data are required as exploration proceeds from the early stages of regional reconnaissance through property acquisition to diamond drilling and discovery. The geoscience data provided by government surveys are used throughout exploration but are most important in the early stages. Highly detailed surveys at the scale of individual mining properties are more appropriately the responsibility of the industry. A number of mapping scales are in common use by government geological surveys. "Regional" maps are typically produced at scales of 1:250,000 or 1:100,000. More detailed mapping is most commonly carried out at a scale of 1:50,000. However, a number of jurisdictions have found systematic mapping of mature mining camps at a scale of 1:20,000 to be very effective in stimulating new exploration and discoveries. For the purposes of its evaluation, the Task Force has grouped mapping requirements into two general categories: regional, which includes scales of 1:100,000 or less, and detailed, for mapping at scales larger than 1:100,000.

As noted above, geoscience maps and data become less useful and eventually obsolete over time as a result of advances in science and technology. For example, a scientific advance of particular relevance to exploration in Canada was the recognition that massive base metal sulphide deposits such as those at Bathurst, Noranda and Flin Flon formed at or near the ancient seafloor rather than deep within the Earth's crust. Similarly, the transition from analogue to digital technologies has had a significant impact on the quality of geophysical surveys. It is relatively easy, at least in principle, to evaluate the utility of existing maps and data. It is much more difficult to forecast the impact of future

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2 *The geoscience knowledge requirements of oil and gas exploration are somewhat different than those of mineral exploration, particularly in respect to the need for subsurface data. Although the mandate of the Task Force was to address the latter, it did commission an assessment of the subsurface mapping needs which is included here as Appendix B.*

scientific and technical advances. In any case, it is important to understand that the geoscience mapping of the Canadian landmass will never be "finished". Moreover, barring an enormous infusion of funds, it is unlikely that the geoscience knowledge pertaining to Canada's immense landmass could ever be made "complete" at any given point in time: it will always be a work in progress.

The approach taken by the Task Force has been to establish a realistic ten year goal for government surveys which, if achieved, would sustain the geoscience knowledge base as a significant competitive advantage for Canada in attracting mineral exploration. The Task Force arrived at this long term goal by a three stage process:

1. Documentation of the state of existing coverage at regional and detailed scale for four critical types of geoscience data: bedrock geology, surficial geology, airborne geophysics and drainage sediment geochemistry.

2. Compilation of established geoscience priorities for each jurisdiction. The process whereby priorities are determined varies from jurisdiction to jurisdiction, but typically involves stakeholder consultation and validation by an industry liaison committee.

3. Estimation of the incremental expenditures required to achieve the desired level of coverage *(i.e.,* the shortfall between total costs needed to achieve the desired level of coverage and current budgets). For the purposes of this summary report, these target expenditures are presented in an aggregated form. The budget and cost estimates, broken down by jurisdiction, are provided in Appendix C.

RESULTS

Bedrock geology

Of all the different types of geoscience knowledge, bedrock geological maps and data are arguably the most important for mineral exploration. As a first order goal, up-to-date regional bedrock geology maps should be available for the entire Canadian landmass at a minimum scale of 1:250,000. It is estimated that adequate regional bedrock coverage exists for approximately 65% of Canada. Most of the areas lacking adequate first generation regional mapping are in northern Canada, particularly in Nunavut and the Northwest Territories, northern Ontario and Quebec, and Labrador. The Task Force is pleased to observe that Quebec has allocated sufficient budget to virtually complete regional mapping of the province by 2005. Current levels of mapping activity elsewhere in the North, however, are insufficient to stimulate a satisfactory level of mineral exploration.

While regional geological maps are often sufficient to attract exploration to frontier areas, more detailed maps at scales of 1:50,000 or 1:20,000 are the norm for more mature areas. The Task Force recommends that government surveys aim to achieve detailed coverage of at least those parts of the country with existing infrastructure or established mineral potential. The proportion of the area recommended for coverage at this scale in each jurisdiction varies considerably across the country according to the maturity of exploration and magnitude of the task. For example, while complete coverage is seen as a realistic goal in the Maritimes and the Island of Newfoundland, the recommended levels of spending in the larger provinces would be sufficient to cover only areas of highest mineral potential.

Surficial geology

Approximately 95% of the Canadian landmass has been glaciated and is now covered by variable thicknesses of glacial drift. Knowledge of the distribution and nature of these surficial materials has a number of applications in mineral exploration of which the most important over the last decade has been in the search for diamond deposits. This information is also critical for the planning and environmental assessment of proposed

mining development projects. As in the case of bedrock geology, regional surficial geology maps should be available for the entire country. Detailed surficial maps are generally a lower priority for mineral exploration, except in specific projects.

Airborne Geophysics

Governments in Canada undertake several kinds of airborne geophysical surveys including magnetics, electromagnetics and gamma-ray spectrometry. The Task Force examined only one of these - regional aeromagnetic surveys with a flight line spacing of 800 metres. Although mineral deposits have occasionally been discovered as a direct result of regional aeromagnetic surveys, the principal applications are as an adjunct to bedrock mapping. Magnetic patterns are especially useful in revealing regional structural trends and in following geological units beneath overburden. About 80% of Canada's landmass has been covered at least once by aeromagnetic surveys. However, nearly 50% of these surveys are more than 30 years old and were done using analogue rather than modern, digital technologies. Moreover, the position control on older surveys does not approach what is possible now using Global Positioning Systems (GPS). The Task Force is recommending that over the next ten years, the aeromagnetic coverage of Canada be completed and that approximately 50% of the early surveys using old technology be re-flown to modern standards. The latter is admittedly an arbitrary figure. It would be preferable if the entire data base would be brought quickly up to modern standards: however, the cost of doing this is likely prohibitive. Moreover, in some areas, it may be preferable to undertake new surveys at a more detailed scale. The Task Force would also like to emphasize the importance of co-ordinating geophysical data acquisition with geological mapping such that the geophysical results are available at the beginning of geological work.

Geochemistry

The weathering of mineral deposits often produces a geochemical signature in the surrounding surficial materials, water and vegetation. Because these signatures are typically larger than the deposits themselves, geochemical surveying is a powerful exploration tool. Government geological surveys often carry-out geochemical surveys at a reconnaissance scale to identify broad geochemical patterns which, in turn, attract the attention of industry to do more detailed work. As with geophysics, there are a number of different kinds of geochemical surveys. Drainage sediment geochemistry is the approach that has been most widely used in Canada for systematic regional reconnaissance. This involves the collection and analysis of either stream or lake sediment material, depending upon the physiography of the area in question. Approximately one-quarter of the Canadian landmass has already been covered with a spacing of one sample per 10 to 15 square kilometres. The Task Force recommends completion of reconnaissance drainage sediment geochemistry coverage in those parts of Canada that are amenable to this method. The Task Force also endorses the selective application of more detailed geochemistry as required to stimulate exploration.

Cost of Achieving the Goal

The results of the analysis are summarized in Table 1. It will be appreciated that costs of survey activities can vary greatly from place to place depending upon topography, the proximity to infrastructure, and other factors. Moreover, in its efforts to summarize the priorities across all jurisdictions, the Task Force has inevitably made some assumptions which will not be accepted by all stakeholders. Therefore, these amounts should not be viewed as precise costs but rather as indicative of the order of magnitude of expenditures required to achieve the stated goals.

The analysis indicates that the total cost of achieving the recommended level of coverage for the four categories of survey data examined by the Task Force would be $674 million. Canada's geological surveys currently spend approximately $31.1 million annually on these kinds of geoscience mapping. Therefore, at current funding levels, there would be a

shortfall of $363 million relative to what would be required to achieve this target in 10 years. This implies an average additional expenditure of $36 million annually. The calculation is very sensitive to the time period. For example, if the time period for achieving the goal were extended to 12 years, the shortfall would be reduced to $301 million and the incremental expenditure to about $25 million/year. However, it should be remembered that the geoscience needs and priorities were defined on a 10 year time horizon and, whereas an extension of two years might not have a large impact, diluting the effort over a much longer period probably would, due to the increasing obsolescence of existing data.

It is important to understand that these projected funding requirements are not intended to reflect the total budgets of Canada's geological surveys. These figures represent what the Task Force considers as a minimum level of mapping to remain competitive in terms of mineral exploration. To put this in context, the aggregate budget of all government surveys in 1998/99 amounted to $113 million. Thus, the activities subject to analysis by the Task Force currently represent about 28% of the cumulative budgets of these organizations, and the incremental increase required to achieve the 10 year goal implies an average 32% increase in total budget.

The Task Force is satisfied that there is little scope for internal budget reallocation within the surveys to achieve its target. The surveys are charged with delivering a number of other activities of importance to a range of clients, including the mining industry. In the provinces, these include such things as resident geologists offices, mineral inventory and assessment, and work in support of the energy sector. For its part, the Geological Survey of Canada has significant responsibilities in such areas as marine geoscience and mitigating natural hazards (*e.g.*, earthquakes, permafrost, magnetic storms).

Table 1: Costs to Achieve Recommended Level of Geoscience Map Coverage

Survey Type	Total Cost To Achieve Target (millions)	Current Budget Capacity* (millions)	Incremental Cost Over 10 Years (millions)
Bedrock Geology - regional scale	$216	$114	$102
Bedrock Geology - detailed scale	$218	$134	$84
Surficial Geology - regional scale	$58	$23	$35
Surficial Geology - detailed scale	$44	$14	$30
Airborne Geophysics - regional scale	$70	$5	$65
Geochemistry - regional scale	$42	$5	$37
Geochemistry - detailed scale	$26	$16	$10
Totals	$674	$311	$363

* *Cumulative current budgets for listed activities multiplied by 10 years*

3 *For example, Appendix B indicates that an expenditure $12 million/year over the next 20 years would be required to meet the subsurface mapping needs of hydrocarbon exploration and development.*

Potential Benefits

In both its report on *Alternative Funding Arrangements for Government Geological Surveys*, presented to Mines Ministers in 1998, and in the current study, the Task Force has underlined the direct relationship between the investment by government in publicly-accessible geoscience and the investment by industry in mineral exploration. While geoscience knowledge is only one of the factors influencing investment decisions, it is a fundamental consideration in reducing the risk inherent in mineral exploration. Although the linkage between government geoscience and mineral exploration has been well-documented in qualitative terms, there have been few attempts to quantify the impact of the government's investment. However, there is a growing body of evidence to suggest that government expenditures on geoscience will result in four to five times as much spending on the part of the private sector. This being the case, the incremental expenditure required to achieve the goal established by the Task Force would be expected to generate on the order of $1.4 to $1.8 billion in private sector exploration activity.

CONCLUSIONS

(Prepared by the Industry Members of the Task Force)

The industry members of this Task Force have worked closely with their federal and provincial colleagues on this study. However, the comments which follow were written only by the industry members of the Task Force.

1. We cannot emphasize too strongly the direct relationship between government geoscience, mineral exploration investment and the discovery and production from new mineral deposits. Other countries with untapped mineral wealth also recognize this relationship and are becoming more competitive for exploration dollars with each passing year.

2. It is clear that the continued erosion of funding for government geoscience has contributed to Canada losing its competitive edge as a place to invest in mineral exploration.

3. There has been a significant change in the structure of mineral exploration industry in the past decade. Junior companies are increasingly doing the majority of early stage grassroots exploration, adding value to the properties and marketing the advanced properties to major mining companies. These junior companies cannot fund large regional studies and will therefore invest their exploration dollars in areas with good geoscience databases either here or abroad.

4. There are large areas of this country that have never been mapped in sufficient detail. There are many areas where geophysical data is outdated and needs to be redone by new high resolution methods.

5. Many of the areas for which regional and or detailed maps exist were mapped many years ago and do not incorporate either current geoscientific thinking or new understanding of the occurrence and formation of mineral deposits. For example, two decades ago we did not know that Canada was about to become a diamond producing country.

6. The status reviews of geoscience map coverage done by the provinces and territories have been approached slightly differently in each case but the results have a similar theme. In general, there is a large gap between the current level of effort and the effort required to:

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4 *This evidence has been summarized in a recent study undertaken by R.B. Boulton & Associates on behalf of Natural Resources Canada .*

- ✓ Cover all areas of the country that have either not yet been mapped or not surveyed at a satisfactory scale; and,

- ✓ Update maps and surveys to incorporate advances in geoscientific thought.

7. When we first approached the problem of *"how much government geoscience is enough"*, we quickly came to the conclusion that, although it would be wonderful if we could cover every part of this country with regional and detailed bedrock and surficial mapping, geochemistry and geophysics, it was neither realistic nor necessary to do so to attract investment to Canada. We have therefore worked together with our government colleagues to formulate a preliminary ten-year target that we believe will get the important relationship between public sector geoscience and private sector mineral exploration back on track. This plan should be viewed as preliminary, but it does outline in general the scope of the total investment required by both levels of government.

8. It should be clearly understood that the approaches that each province and territory need to take to stimulate investment in the mineral exploration sector are different. In the three territories, northern Labrador and northern Quebec, for example, the emphasis needs to be on regional bedrock mapping. In the Maritimes and other southern parts of the country, there is a greater need for more detailed mapping and re-mapping and surveying of areas for which the coverage is outdated. Despite these different needs we believe that the country as a whole would benefit from a national geoscience mapping strategy. We would like to see both levels of government and industry work together to achieve this goal.

RECOMMENDATIONS

The industry members of the Task Force recommend that:

- ✓ In order to stimulate new investment in the mining sector in Canada, a collective commitment to reach the ten-year target proposed by this Task Force should be made by all provincial, territorial and federal governments; and,

- ✓ This target be achieved through a cooperative approach such as a national geoscience mapping strategy.

APPENDIX A

MEMBERSHIP OF THE IGWG TASK FORCE ON ALTERNATIVE FUNDING ARRANGEMENTS FOR GOVERNMENT GEOLOGICAL SURVEYS

Appointed by the Prospectors and Developers Association of Canada

Mary-Claire Ward (Task Force Chairperson)
Vice President
Watts, Griffis and McOuat, Toronto, Ontario

James Robertson
Regional Exploration Manager, Western North America
Falconbridge Ltd., Winnipeg Manitoba

Peter Dimmell
Newfoundland and Labrador Chamber of Mineral Resources,
St. John's, Newfoundland

Appointed by the British Columbia and Yukon Chamber of Mines

Walter Sellmer
President
Energold Mining Ltd., Vancouver, British Columbia

Appointed by the Committee of Provincial Geologists

Ron Smyth
Director and Chief Geologist
Geological Survey Branch
British Columbia Ministry of Energy and Mines, Victoria, British Columbia

Andy Fyon
Senior Manager
Precambrian Geoscience Section
Ontario Geological Survey
Ontario Ministry of Northern Development and Mines, Sudbury, Ontario

Mike Cherry
Director
Mineral and Energy Resources Division
Nova Scotia Department of Natural Resources, Halifax, Nova Scotia

Appointed by the Geological Survey of Canada

Murray Duke
Director General
Minerals and Regional Geoscience Branch
Geological Survey of Canada, Ottawa, Ontario

APPENDIX B

GEOSCIENCE SUBSURFACE MAPPING NEEDS IN CANADA: AN ASSESSMENT OF THE TASK BEFORE US

BACKGROUND

Canada's Sedimentary Basins and Orogens

Depending on the parameters used to differentiate one sedimentary basin from the next , there are at least 40 sedimentary basins in Canada. These range from very large and extensively explored basins (but still with enormous future potential for hydrocarbon and mineral discoveries) like the Western Canada Sedimentary Basin (WCSB), to large but barely explored domains like the Beaufort-Mackenzie Basin, to moderate basins (typically scarcely explored) like the Magdalen Basin in the Gulf of St. Lawrence, to truly tiny and typically complex basins like the Nanaimo Basin in the Strait of Georgia.

Mapping in Four Dimensions

Surface bedrock mapping by government surveys is as vital in sedimentary basins and orogens as it is in crystalline terranes, for it yields the first critical insights into what lies buried in the third dimension. The same can be said for potential field mapping and other form of geophysical characterization. Furthermore, research into time relations - the fourth dimension - is as vital to the understanding of the geology of sedimentary rocks as it is to deciphering the geology of igneous and metamorphic complexes.

But in sedimentary basins, scope exists to systematically characterize the third dimension at a scale and level of sophistication that is simply not possible in most hard rock domains. The justification for doing so is that resources in sedimentary basins are more often than not deeply buried - oil and gas reservoirs, for example. The principal reason that mapping the third dimension is possible, and desirable, in sedimentary domains is that abundant data exist in the third dimension because of direct observations derived from drilling. The level of four-dimensional mapping warranted in any given sedimentary basin is a function of the quantity and quality of available subsurface data.

Basin Data Bases

The WCSB is the only Canadian basin in which the subsurface data base is truly voluminous - raw data are available from over 300,000 oil and gas wells. No other Canadian basin comes close: for example, there are only about 250 wells in the Beaufort-Mackenzie Basin, and on the order of 350 wells for the whole of the east coast offshore. However, many of the most prospective of the frontier basins, like the Jeanne d'Arc Basin off Newfoundland, have tremendous scope for geological characterization in three and four dimensions because of the availability of sophisticated reflection seismic data, tied to borehole control of sufficient density to allow for meaningful interpretation. Much of the seismic information is either publically available or can be accessed through collaboration between government surveys and industry.

SUBSURFACE MAPPING IN THE NEXT 20 YEARS

Subsurface Mapping Priorities

In the next 20 years, subsurface mapping needs to be focused primarily on the WCSB and on the most prospective of the frontier basins. These include the east coast basins of the Grand Banks, the Scotian Shelf, the Labrador Shelf and the Gulf of St. Lawrence, as well as the northwestern mainland sedimentary basins and the

Beaufort-Mackenzie Basin. Somewhat lesser efforts are required in the cratonic basins of central Canada (*e.g.*, Hudson Bay Basin, Michigan Basin) and the Pacific Margin and Intermontane basins of British Columbia, but these will come to the fore in the 20 to 40 year time frame. High Arctic basins such as the Sverdrup and Franklinian require immediate reconnaissance but will not likely warrant detailed subsurface mapping until the 40+ year time frame.

Western Canada Sedimentary Basin

There already exists a modern geological atlas of the WCSB at reconnaissance scale (1:5,000,000) which was compiled at a cost of $12 million. More detailed subsurface mapping by government surveys is warranted at scales of 1:2,000,000 and 1:500,000, as regional underpinning for the more detailed kind of mapping that is traditionally and appropriately done by industry. Building on a detailed analysis conducted by the Saskatchewan Geological Survey, it is possible to extrapolate what completion of such coverage would entail for the entire WCSB.

Table B1: Cost of Completing Subsurface Mapping of the Western Canada Sedimentary Basin

Province	Number of Phanerozoic Formations	Number of Maps	Person-Years Effort	Total Cost ($ million)
Saskatchewan	39	220	35	4
Alberta	70	670	110	13
Northeast B.C.	70	100	18	2
Manitoba	20	70	10	1
Total WCSB				20

It should be emphasized that these figures embrace production not only of basic structure and isopach maps, but also accompanying facies maps, cross sections and descriptions of stratigraphy, lithology and age relations, all founded on a digital data base.

Prospective Frontier Basins

Atlas-scale compilations exist for the Scotian Shelf and Labrador Sea basins on the east coast and for the Beaufort-Mackenzie Basin in the north. They do not yet exist for the Grand Banks, the Gulf of St. Lawrence or the northern mainland basins, although there are plans in the works to move on all three fronts. Such atlas compilations involve extensive and expensive seismic processing and interpretation, in addition to analytical work based on well data. Mapping at 1:2,000,000 is warranted in parts of all of these basins as well. The costs itemized below are based on experience in producing existing atlases and in recent seismic-based mapping projects, mainly in the offshore.

Table B2: Cost to Produce Atlases for Prospective Frontier Basins

Basin	1:5 000 000 Atlas ($ millions)	1:2 000 000 Atlas ($ millions)	Total Cost ($ millions)
Scotian Shelf	—	6	6
Labrador Sea	—	2	2
Grand Banks	6	8	14
Gulf of St. Lawrence	5	5	10
Northern Mainland	8	8	16
Beaufort-MacKenzie	—	8	8
Total	19	37	56

Other Canadian Basins

Reconnaissance-scale subsurface mapping in the cratonic basins of central Canada, the Pacific basins and the Arctic needs to be continued through the coming 20 years, in order to encourage new data acquisition by industry and to foster more detailed mapping and exploration in the 20 to 40 year time frame. Many of these basins offer significant public-sector data holdings (not yet analyzed), and industry has shown itself increasingly willing to share previously proprietary data with government surveys. Reasonable subsurface mapping expenditures in these realms will cost some $14 million in the coming 20 years.

Summary - The Next 20 Years

It should be emphasized that all of the above figures relate only to the subsurface mapping component of the overall basin analysis work that is to be done in the coming 20 years. Other aspects of basin analysis (*e.g.*, basic stratigraphy, sedimentology, paleontology, geochemistry, geodynamics, structural geology, tectonics and modelling), the antecedents and beneficiaries of systematic mapping, must proceed as well. The cost of these associated studies is estimated to be of the same order of magnitude as that of the systematic mapping components, about $ 90 million (*i.e.*, $20 million + $56 million +$ 14 million).

Data Bases

The subsurface mapping and associated studies described above are contingent on the availability of appropriate subsurface data bases. The annual cost of data entry and data base maintenance across Canada is estimated at $ 3 million, for a total of $ 60 million over 20 years. The projected cost of systematic subsurface mapping and associated basin analysis in Canadian sedimentary basins and orogens for the next 20 years are summarized in Table B3.

Table B3: Projected Cost of Systematic Mapping and Basin Analysis Over the Next 20 Years

Component	Total Cost ($ millions)
Western Canada Sedimentary Basin	20
Frontier Basins Prospective Immediately	56
Frontier Basin Prospective in Long Term	14
Basin Analysis Studies	90
Data Entry and Data Base Management	60
Total	240

SUBSURFACE MAPPING IN THE 20 to 40 YEAR TIME FRAME

As suggest above, the emphasis will shift in the 20 to 40 year time frame to more detailed subsurface mapping in the developing frontier basins of the east coast and the northern mainland, with attendant increase in the need for synthesis subsurface mapping in the more distant frontiers like the Arctic. It is expected that cost associated with such efforts will be on the same order as that expected for the coming 20 years, about $100 million.

SUBSURFACE MAPPING IN THE 40+ YEAR TIME FRAME

If predictions for the 20 to 40 time frame are subject to considerable uncertainty, then equivalent projections for the 40+ year term are fraught with same. Suffice to say that, in support of resource development, and for multiple other environmental and social purposes, there will be continuing need for first-class geoscientific knowledge of the geology of Canada's sedimentary basins and orogens. As always, this geoscientific knowledge will be most fundamentally predicated on the availability of subsurface maps.

APPENDIX C

MAPPING REQUIREMENTS 2000 TO 2010 BREAKDOWN BY JURISDICTION

The following tables summarize the input received from each jurisdiction with respect to geoscience mapping needs over the next ten years.

For the purposes of the consolidated requirements summarized in Table 1 (above), figures provided by the Geological Survey of Canada were used for the regional scale requirements for surficial geology ($36 million), geochemistry ($3.3 million) and airborne geophysics ($70 million). Thus, Table 1 is not simply the sum of the individual submissions tabulated below.

Newfoundland and Labrador

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100 000)	11	0.9	10.6
	Detailed (>1:100 000)	8.6	—	—
Surficial geology	Regional (<1:100 000)	7	0.1	6
	Detailed (>1:100 000)	4.5	0.25	2
Geochemistry	Regional (<1:100 000)	3	—	3
	Detailed (>1:100 000)	2	0.08	1.2
Totals		36.1	1.33	22.8

Nova Scotia

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	5	0.5	0
Surficial geology	Regional (<1:100,000)	1.75	0.1	0.75
	Detailed (>1:100,000)	—	—	—
Geochemistry	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Totals		6.75	0.6	0.75

New Brunswick

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	2.8	0.46	3.4
	Detailed (>1:100,000)	5.2	—	—
Surficial geology	Regional (<1:100,000)	3.2	0.31	3.1
	Detailed (>1:100,000)	3	—	—
Geochemistry	Regional (<1:100,000)	0.5	—	0.5
	Detailed (>1:100,000)	0.5	—	0.5
Totals		15.2	0.77	7.5

Quebec

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	18	4.3	-25
	Detailed (>1:100,000)	46	1.6	30
Surficial geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Geochemistry	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Totals		64	5.9	5

Ontario

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	27	3.3	35
	Detailed (>1:100,000)	41	—	—
Surficial geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	12.5	0.5	7.5
Geochemistry	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	5.2	0.5	0.2
Totals		85.7	4.3	42.7

Manitoba

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	1.5	0.075	0.75
	Detailed (>1:100,000)	37	1.235	24.65
Surficial geology	Regional (<1:100,000)	1.3	—	1.3
	Detailed (>1:100,000)	1.2	0.12	—
Geochemistry	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	4.5	0.45	—
Totals		45.5	1.88	26.7

Saskatchewan

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	6.8	0.51	1.7
	Detailed (>1:100,000)	10	0.558	4.42
Surficial geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Geochemistry	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Totals		16.8	1.068	6.12

Alberta

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	12	0.3	9
	Detailed (>1:100,000)	10.5	—	10.5
Surficial geology	Regional (<1:100,000)	7.5	0.5	2.5
	Detailed (>1:100,000)	17.5	—	17.5
Geochemistry	Regional (<1:100,000)	7.5	0.25	5
	Detailed (>1:100,000)	5	—	5
Totals		60	1.05	49.5

British Columbia

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	15.5	—	15.5
	Detailed (>1:100,000)	34	1.65	17.5
Surficial geology	Regional (<1:100,000)	1	—	1
	Detailed (>1:100,000)	5.5	0.1	4.5
Geochemistry	Regional (<1:100,000)	5	—	5
	Detailed (>1:100,000)	6	0.4	2
Totals		67	2.15	45.5

Nunavut

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	69.2	1.2	57.2
	Detailed (>1:100,000)	—	—	—
Surficial geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Geochemistry	Regional (<1:100,000)	21	—	21
	Detailed (>1:100,000)	—	—	—
Totals		90.2	1.2	78.2

Northwest Territories

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	41	—	41
	Detailed (>1:100,000)	8.9	0.2	6.9
Surficial geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Geochemistry	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Totals		49.9	0.2	47.9

Yukon

Type of Mapping	Scale	Cost To Meet Goal ($ millions)	Current Annual Budget ($ millions)	Shortfall Over Ten Years ($ millions)
Bedrock geology	Regional (<1:100,000)	11.7	—	11.7
	Detailed (>1:100,000)	11.7	0.5	6.7
Surficial geology	Regional (<1:100,000)	—	—	—
	Detailed (>1:100,000)	—	—	—
Geochemistry	Regional (<1:100,000)	2	—	2
	Detailed (>1:100,000)	2.5	0.15	—1
Totals		27.5	0.65	20.4

Geological Survey of Canada Budget Allocation to Activities Reviewed by Task Force*

Type of Mapping	Current Annual Budget ($ millions)
Bedrock geology	7.5
Surficial geology	1.7
Geochemistry	0.3
Geophysics	0.5
Total	10

**Reference level funding only*

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